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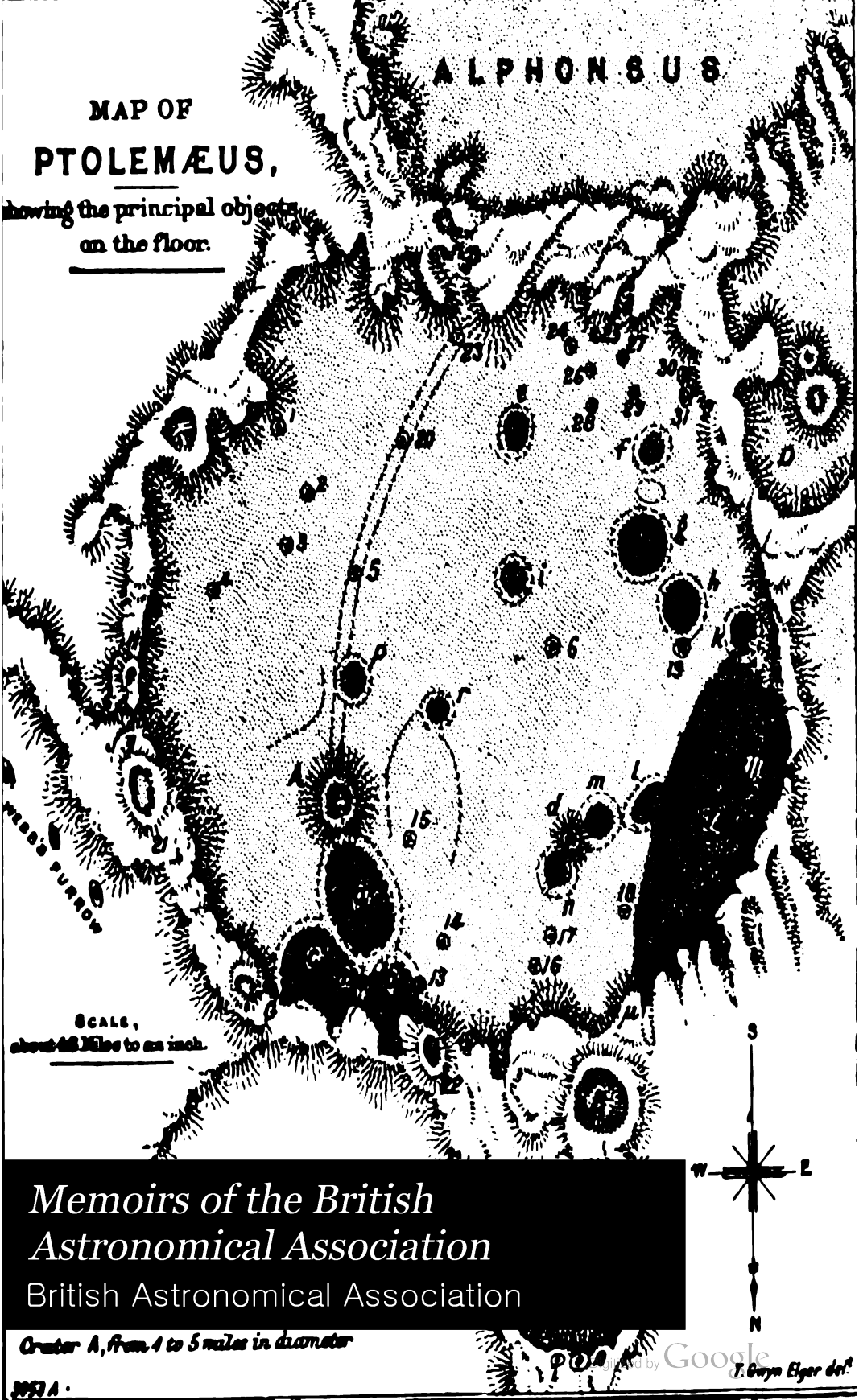


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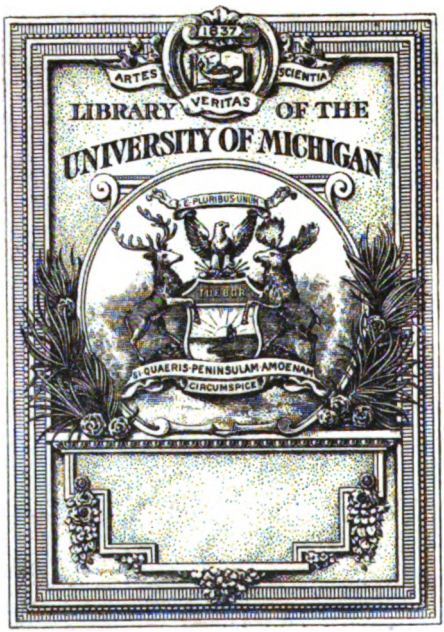


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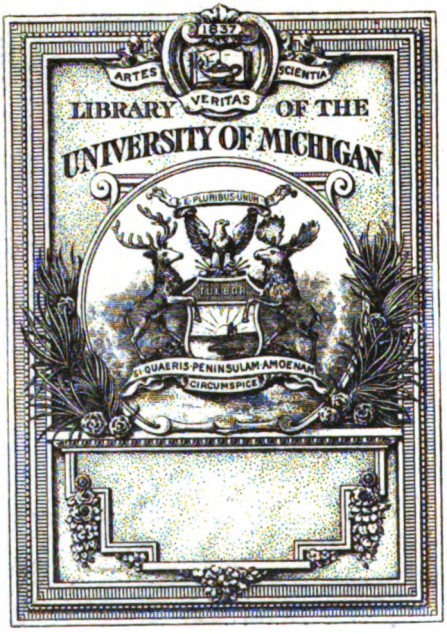


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# Memoirs

OF THE

# British Astronomical Association.

EDITED BY

**A. S. D. RUSSELL.**

REPORTS

OF THE

## OBSERVING SECTIONS,

1895.

VOL. III.

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# INDEX.


Page

**PART I.—Second Report of the Meteoric Section (Henry Corder, Director):—**

Introduction and List of Members of the Section - - - 1
Meteor Showers, 1892–3 - - - - - - 2
List of Meteor Radiants observed in 1892–93 - - - - 17
Bright Meteors observed by Members of the British Astronomical Association - - - - - - 23
Heights and Radiants of Meteors, 1892–93 - - - - 27

**PART II.—Second Report of the Variable Star Section (J. E. Gore, F.R.A.S., M.R.I.A., Director):—**

Introduction - - - - - - - 29
Members of the Section - - - - - 29
Observations of Variable Stars in 1893, Henry Corder - - 30
Short Period Variables - - - - - 31
Observations of Variable Stars in 1892, Lieut. Col. E. E. Markwick, F.R.A.S. - - - - - - 32
Miscellaneous Observations - - - - - 35
Observations of Variable Stars from May 1892 to January 1894, by Joao de Moraes Periera - - - - - 37
Conclusion - - - - - - 48

**PART III.—Third Report of the Solar Section (Miss E. Brown, F.R.Met.S. Director):—**

Introduction - - - - - - 49
Members of the Section - - - - - 50
Calendar of Sun-spots and Faculæ - - - - - 51
Sun-spot Ledger 1893 - - - - - - - 57
Solar Statistics in 1892 - - - - - 119

**PART IV.—Third Report of the Jupiter Section (Rev. W. R. Waugh, F.R.A.S., Director):—**

Members of the Section - - - - - 121
Introduction - - - - - - - 122
Drawings by Members of the Section - - - - 133
Observations of Jupiter by A. Stanley Williams, F.R.A.S. - - 138
Observations of the Satellites, by Members of the Section - - 141
Summary, by The Director of the Section - - - 145





148387

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PART V.—Third Report of the Lunar Section (T. Gwyn Elger, F.R.A.S., Director) :—


| | Page |
|---|---|
| Introduction | 151 |
| Members of the Section | 152 |
| Ptolemaus | 153 |
| Vendelinus | 159 |
| Aristarchus and Herodotus | 160 |
| Billy | 162 |
| Gassendi | 163 |
| Hyginus N | 164 |
| Mädler | 167 |
| Mare Serenitatis | 169 |
| Mersenius | 170 |
| Petavius | 171 |
| Plato | 172 |
| Posidonius | 174 |
| Schickard | 175 |
| Thebit, and the Straight Wall | 175 |
| Miscellaneous Observations (*Arzachel, Bessel, Capella, Cassini, Clavius, Copernicus, Fracastorius, Goclenius, Guttemberg, Hippalus, Kies, Landsberg, Linné, Lohrmann, Hevel, Cavalerius, Mare Humorum, Mare Nubium, Messier and Messier A, Tobias Mayer, Otto Struve, Piccolomini, Plinius, Theophilus*) | 177–179 |
| Total Eclipse, 1895, March 10 | 180 |


## ILLUSTRATIONS.


6 Plates of Sun-spots (end of Report of Solar Section).
Diagram illustrating Jupiter's Belts - 123
2 Plates, 30 Drawings of Jupiter (end of Report of Jupiter Section).
6 Plates of Lunar Details (end of the Report of Lunar Section).


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# SECTION FOR THE OBSERVATION

OF

# METEORS.

DIRECTOR.—HENRY CORDER.

## REPORT OF THE SECTION,

### Introduction.

The Meteoric Section during the past 15 months has consisted of the following Members:—

| Name. | Address. |
|---|---|
| Backhouse, T. W., F.R.A.S. - | West Hendon House, Sunderland. |
| Blakeley, E. R. - - | 26, Victoria Crescent, Dewsbury. |
| Booth, David - - - | 70, North Street, Leeds. |
| Corder, Henry - - - | Sunnyside, Bridgwater. |
| Davis, G. T. - - - | 13, Donnington Gardens, Reading. |
| Denning, W. F., F.R.A.S. - | Shannon Court, Corn Street, Bristol. |
| Ferrington, F. H. - - - | 36, Albert Street, Shrewsbury. |
| Johnson, Rev. S. J., F.R.A.S. - | Melplash Vicarage, Bridport. |
| Milligan, W. H. - - | 125, McClure Street, Belfast. |
| Plassmann, J. - - - | Warendorf, Germany. |
| Pope, James T. - - - | 2, Bridaig Avenue, Dingwall. |

Others, whose names will be found in the Report, have kindly contributed observations, and it is hoped that some of them are about to become Members of the Section. The Director will be



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very glad to hear of fresh names of real workers, for ill-health has robbed the Association of a great deal of help which it would doubtless have continued to receive from Mr. Denning, Mr. Blakeley, and others, who, it is hoped, will soon regain their strength. The Director desires to thank most heartily all who have helped him in this very interesting work, and to ask for assistance again during the coming year, not only from the regular workers, but also from any who will send him chance observation they may make of brilliant meteors, giving as many details as possible. In the following pages will be found detailed reports of some of the best known meteor showers seen in the period from October 1, 1892, to December 31, 1893; a catalogue of radiant points during the same time; a list of bright meteors and fireballs; and a table showing the heights and real paths of 15 meteors, kindly contributed by Mr. Denning.

HENRY CORDER,
Director of the Section.

---

## Meteor Showers, 1892-93.

ORIONIDS OF OCTOBER, 1892.

This shower was not well observed at this return, as the weather was not very good. Three observers report on it, the following being a summary of their observations.

Mr. W. H. Milligan, of Belfast, found a radiant of Orionids at 92° + 15°, between the dates of October 19 and 23 other bright meteors were apparently directed from Gemini.

Mr. T. W. Backhouse, of Sunderland, was watching on various dates from October 16 to 29, the best display of Orionids being on the 18th, with a radiant at 90° + 17°, and meteors were also directed from near $\gamma$ Geminorum at 98° + 18°, but out of 28 meteors mapped in the whole period, only about eight were conformable to either of these showers.

The Director, at Bridgwater, was on the watch on about 14 nights in October, especially on the 17th, 23rd, and 29th, but on the last named date the combined shower of Orion-Geminids had almost ceased. In this period only nine meteors, out of a total of 177, were true Orionids, with a radiant at 87° + 18°, but 22 more were from the Geminid positions near $\nu - \gamma - \xi$, or at 96° + 18°, 99° + 15°, and 98° + 11°, the first named agreeing very well with the five tracks of Mr. Backhouse. Indeed, this Geminid display has seemed to the Director to be the more important of the two on some occasions, especially after the chief Orionid dates (October 16 and 17). The meteors from Orion are very swift, and though very rarely above second magnitude, almost invariably leave streaks, even in larger proportion than the Perseids. The meteors from near $\gamma$ Geminorum are somewhat similar, but are often much brighter, and three beautiful yellow meteors, rather brighter than first magnitude, were recorded, all leaving streaks. It does not appear that there is much shifting of



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the Orionid radiant. Mr. W. F. Denning has found it pretty stationary at various times, and the writer has also noticed the exact character of the radiation, and as the two showers may be observed at the same time, it cannot be a case of shifting, though they might be branches of one shower; the difference in the character of the meteors is, however, against this view.

TAURIDS OF NOVEMBER 1892.

This long-continued shower was observed by several Members of the Section, and the main radiant point near A Tauri well determined, as under:—

| | | |
|---|---|---|
| 65° + 20° | - | Milligan. |
| 60° + 21° | - | Pope. |
| 60° + 21° | - | Rheden. |
| 59° + 21° | - | Corder (20 meteors). |

Besides these, there were two other positions mapped from Bridgwater, one near Aldebaran at 73° + 16°; the other near the Pleiades at 55° + 24° (13 meteors). The first has often been seen before, though it is but a feeble stream, the meteors orange, and very slow. That near the Pleiades has shown some signs of shifting in the direction of A Tauri, but no actual junction with the latter shower has been seen. The shower is earlier than the true Taurids, commencing in October, and the meteors somewhat quicker and with shorter paths.

The true Taurids last all through November, and are a very interesting shower, though it is not often that more than five or six can be seen in an hour. In 1892 the middle of the month was cloudy, so that only scattered observations were made, and none of the green fireballs, which often characterise the shower, were seen.

THE ANDROMEDES OF NOVEMBER 1892.

A great shower of these meteors was expected this season, on or about the 27th, but it did not show itself in England. Certainly, the weather was cloudy, but information received from the Tyrol, where Herr Joseph Rheden was observing them, would go to prove that the shower had not commenced on the evening of the 23rd in this hemisphere, but that in America a splendid shower was in progress when night set in there. The stream has evidently suffered some perturbation of its orbit, for not only was the radiant far from its usual position north of $\gamma$ Andromedæ, but the date was also much earlier; the maximum display being on the 23rd, whilst on the 26th and 27th scarcely a member of the shower was seen.

It will not be necessary to reproduce the long list of radiant positions here, they will be found in the general list. Suffice it to say, that when first seen at Bridgwater, on November 19, there was a large area of radiation, extending from near $\beta$ Andromedæ to $\tau$ in the same constellation, and even as far as $\gamma$ Trianguli. A watch was kept on this night both before and after midnight.



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In about five hours 74 meteors were seen, of which about 30 were Andromedes, and at one time in the evening they were falling at the rate of 12 an hour. During a short interval on the evening of November 20, four Andromedes were seen; but clouds came on, and nothing more was seen of the shower excepting during a brief watch on November 26, when it was dying out.

On November 23, Herr Rheden saw 40 meteors between $7^h\ 26^m$ and $10^h\ 20^m$, of which a large proportion were Andromedes, and a few more on November 24. This observation forms an interesting link in the history of the shower, carrying it on until the great storm of meteors seen in America on the evening of the 23rd, and showing that it was almost over again by the same time on November 24 in Europe.

At Sunderland, Mr. Backhouse was very unfortunate. He missed the early apparition of the shower, and his watch on the nights of November 24, 26 to 28, lasting for 148 minutes in all (the sky was at times partially overcast), gave him only six meteors, none of which appear to have belonged to the expected shower.

Herr J. Plassmann, at Warendorf, had a similar experience on the dates November 22, 25, and 26, the other nights being overcast.

Miss E. Brown reports that a gentleman at Cirencester saw quite a minature shower of meteors in the S.W. between $10^h\ 30^m$ and $10^h\ 45^m$ on the night of November 26, but Miss Brown herself saw nothing in short watches before that hour.

At Belfast, Mr. Milligan saw a few meteors radiating from $25° + 45°$ above $\gamma$ Andromedæ on November 25, no doubt belonging to the shower, and this observation, taken with that made at Bridgwater on the 26th, would seem to show that the radiant had moved on from near $\beta$ Andromedæ on the 19th to near $\gamma$ by the later date, thus taking up its usual position in other years on the 27th of November.

At Bridport, Rev. S. J. Johnson saw only a few stragglers of the shower, and other observers seem to have had no success.

To summarise these scanty results, it would seem that the shower commenced on the evening of November 19, and reached its maximum on November 23, and that only a few belated meteors remained on the usual date of November 27. Not many bright ones were seen, most of them being of the 3rd and 4th magnitudes only, dull orange in colour and slow in movement. Several of them which had trains appeared as moving streaks during the end of their course, the nucleus having died out. It is to be hoped that observations will continue to be made of this interesting shower, as it is evident that it is not thoroughly understood yet, and the great dispersion of the radiant may throw some light on the question of branch showers, and those large areas of meteoric radiation, such as the Ursids, where the whole of a large constellation seems the outlet for a vast stream of scattered meteors.

The following table shows the details of Mr. Backhouse's watch for meteors of the recently expected Andromede shower. The



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columns will bear the same explanation as those of the Leonid table. (*See* next page.)

| Time. | O. | Sky. | O¹. | Hindrance. | Mag. vis. | F. |
|---|---|---|---|---|---|---|
| 11 mo. 24: | | | | | | |
| 9°20 to 10°5 | 10 | ·6 | 6 | — | — | — |
| 10°15 „ 11°30 | 5 | ·6 | 3 | — | — | — |
| Total | 15 | — | 9 | — | — | 0 |
| 11 mo. 25 | — | — | — | Overcast. | — | — |
| 11 mo. 26: | | | | | | |
| 8°19 to 8°21 | 2 | ·5 | 1 | Moonlight and thin cloud | — | — |
| 12°59 „ 13°21 | 20 | 1· | 20 | Very faint aurora | — | 1 |
| 13°35 „ 13°46 | 5 | 1· | 5 | „ | — | 1 |
| 13°48 „ 13°53 | 2 | 1· | 2 | „ | — | — |
| 17°25 „ 17°31 | 6 | 1· | 6 | — | — | — |
| 17°35 „ 17°55 | 4 | 1· | 4 | — | — | — |
| 17°57 „ 18°5 | 1 | 1· | 1 | Slight twilight. | — | — |
| Total | 40 | — | 39 | — | — | 2 |
| 11 mo. 27: | | | | | | |
| ('92) 4°20 to 4°51 | — | — | — | Not much sky; no stars but γ and Vega seen, and they not very long. | — | — |
| ('92) 5°2 „ 5°3 | 1 | ·3 | ·3 | Twilight and moonlight; then it clouded over. | 4 | — |
| 7°55 „ 8°4 | 6 | ·1 | ·6 | Thin cloud and moonlight | 3 | — |
| 8°34 „ 8°42 | 8 | ·4 | 3·2 | Partly thin cloud and moonlight. | 5–5½ | — |
| ('92) 8°45 „ 8°59 | 14 | ·7 | 9·8 | „ | 6–5½ | — |
| ('92) 9°14 „ 9°18 | 4 | ·7 | 2·8 | „ | 6–5½ | — |
| ('92) 9°28 „ 9°30 | 2 | ·6 | 1·2 | „ | 6½–5½ | — |
| ('92) 9°48 „ 10°5 | 17 | ·9 | 15·3 | Partly thin cloud and slight moonlight. | 6½–6 | 1 |
| ('92) 10°21 „ 10°28 | 7 | 1· | 7 | Slight moonlight | 6½ | 1 |
| 12°55 | 1 | 1· | 1 | Thin cloud | 6½ | — |
| Total | 60 | — | 41 | — | — | 2 |
| 11 mo. 28: | | | | | | |
| 6°0 to 7°30 | 12 | ·5 | 6 | Moonlight and thin cloud. | — | — |
| 10°0 „ 10°10 | 7 | ·4 | 2·8 | Moonlight. | — | — |
| 16°55 „ 17°4 | 5 | ·8 | 4 | — | — | 1 |
| 17°45 „ 18°4 | 7 | 1· | 7 | — | — | 1 |
| 18°17 „ 18°19 | 2 | 1· | 2 | Twilight | 6–6½ | — |
| Total | 33 | — | 22 | — | — | 2 |
| Grand Total | 148 | — | 111 | — | — | 6 |

('92) means spectacles of about that power.



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## LEONIDS OF NOVEMBER 1892.

The weather was not favourable at the time of the Leonid shower, but Mr. Backhouse was able to watch on the early morning of November 15, when between two and six o'clock (50 minutes watching) only two meteors were seen, both believed to be Leonids. Again, on the morning of November 17, a watch was kept for 70 minutes, when six meteors were seen, none of them Leonids. On the morning of November 20, at Bridgwater, in about four hours only four Leonids were seen, the radiant being much further to the south-east than usual, near $\gamma$ Leonis at $153 + 21\frac{1}{2}$. Still there is very little doubt, by the appearance of the meteors, that they were members of the true shower which seems to have reached a very low point now, and does not seem at all to increase in intensity as the time for its maximum in 1899 approaches.

## LEONIDS, NOVEMBER 1892.

Mr. Backhouse gives the following account of his watch for Leonids this year. "O" means the total number of minutes watch in the interval mentioned in the previous column; "Sky," the proportion of clear sky visible; "$O^1$," the number of minutes corrected for "sky"; "Hindrance," other hindrances to visibility of meteors; "Mag. vis.," the faintest stars visible; "F," the number of meteors seen in each interval of first column; and $\Omega$ the number of meteors taken to be Leonids at the time of observation.

| Time. | O. | Sky. | $O^1$. | Hindrance. | Mag. vis. | F. | $\Omega$ |
|---|---|---|---|---|---|---|---|
| 11 mo. 14: | | | | | | | |
| 13°37 to 14°8 - | 16 | ·9 | 14 | — | — | 0 | — |
| 14°40 „ 15°40 - | 7 | ·8 | 5 | — | — | 1 | 1 |
| 16°59 „ 17°37 - | 22 | ·7 | 16 | Slight moonlight - | 6¾ | 1 | |
| 17°53 „ 18°2 - | 5 | ·8 | 4 | Do., and twilight - | 6¾ | (1)* | 0 |
| Total - | 50 | — | 39 | — | — | 2 | 2 |
| 11 mo. 16: | | | | | | | |
| 8°51 to 9°11 - | 17 | 1· | 17 | — | — | 4 | 0 |
| 10°50 „ 12°57 - | 18 | 1· | 18 | — | — | 1 | 0 |
| 16°55 „ 17°53 - | 30 | 1· | 30 | — | — | 1 | 0 |
| 18°5 „ 18°10 - | 5 | 1· | 5 | Twilight - - - | 6¾ | 0 | — |
| Total - - | 70 | — | 70 | — | — | 6 | — |
| Grand Total - | 120 | — | 109 | — | — | 8 | 2 |

* Seen with field-glasses and not included in totals.



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GEMINIDS OF DECEMBER 1892.

This shower was very well observed in several places, although what should have been the best nights (December 10 and 11) were more or less overcast.

At Bristol, Mr. Denning was watching for some time, especially on December 12, and registered a number of Geminids, an account of which he has sent to the "Monthly Notices." As Prof. A. S. Herschel was watching at Slough, and the writer at Bridgwater, several meteors were found in the lists common to two or three observers, and Mr. Denning worked out the true paths, which are given, by his kind permission, in another part of this report. Mr. Backhouse and Mr. Milligan also saw something of the shower. It was evident that there was a double centre of radiation, one shower being directed from Castor, and another from near Pollux; a third being suspected near $\theta$ Geminorum. Perhaps it is not necessary to reproduce the list of radiants here, as they are given in the general table.

Generally the meteors of this shower are very small and uninteresting, having short paths and rarely leaving streaks; but on this occasion a good many bright ones were seen, especially perhaps from the Pollux radiant, which has been observed in former years, though hardly so strongly marked before.

At Bridgwater 73 meteors of the combined showers were counted, only nine of the brightest leaving any streaks. The magnitudes were as follows:—12 1st mag., 17 2nd mag., 24 3rd mag., 20 4th, and smaller. Five of them were coloured yellowish green. This shows just twice as many of the two brighter magnitudes as there were in 1877, when exactly the same number of Geminids were registered.

On December 12 the hourly number of Geminids reached 14.

There is often a shower of long streak-leaving meteors from near $\iota$ or $\delta$ Gem., which is contemporaneous with the earlier part of the Geminid display. Nothing was seen of it this year by either of the observers.

THE QUADRANTIDS OF JANUARY 1893.

The very brilliant full moon and cold weather prevented most observers from seeing anything of this shower, although short watches were kept in some places. Fortunately, at Belfast, Mr. Milligan braved both cold and moonlight, and was very justly rewarded by what, under the circumstances, must have been an unusually fine display of these meteors. He writes, "I kept "watch on the night of January 2, from 12·0 till 2·0 a.m., and "during that time counted upwards of 25 meteors, some of them "rather bright in the strong moonlight. The radiant was well "marked at 230° + 50°. They apparently slacked off towards "2 a.m., when I retired. They, however, were still visible the "following evening, as I saw one myself, and heard of several "others being seen in the N.E. sky."

The great fireball seen on the evening of January 4, at several places, rivalling the moon in splendour, may have belonged to this shower. Mr. Backhouse, who was wintering in Tenerife, was also on the watch, but only saw five Quadrantids.



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WATCH FOR QUADRANTID METEORS, 1892–3.

| Time of Watching. | Minutes of Observations. | Area of visible Sky. | Minutes of Observations corrected for Sky. | Hindrance to Visibility. | Magnitude of faintest Stars Visible. | Number of Meteors seen. | Rate per Hour. | Number of Quadrantids seen. |
|---|---|---|---|---|---|---|---|---|
| *At Santa Cruz de Tenerife.* 1892, 12 mo. 30: | | | | | | | | |
| 18°30 to 18°50 - | 5 | ·9 | 4·5 | — | — | 0 | — | — |
| *At Puerto Orotava, Tenerife.* 1892, 12 mo. 31: | | | | | | | | |
| 18°43 to 19°10 - | 7 | 1· | ·7 | Moonlight and slight twilight. | — | 1 | 8·6 | 1 |
| *At Puerto Orotava.* 1893, 1 mo. 1: | | | | | | | | |
| ('92) 18°26 to 18°43 - | 7 | ·4 | 2·8 | Bright moonlight. | 4½ | 2 | 40 | 2 |
| ('92) 18°45 „ 19°0 - | 14 | ·5 | 7 | „ | — | 3 | 25·7 | 2 |
| ('92) 19°1 „ 19°12 - | 11 | ·2 | 2·2 | Bright moonlight and slight twilight. | 4 | 0 | 0 | 0 |
| Total - - | 32 | — | 12 | — | — | 5 | 25·0 | 4 |
| *At Puerto Orotava.* 1 mo. 2: | | | | | | | | |
| — ('92) } 17°26 to 19°12 { | 31 | 1· | 31 | Bright moonlight, and at end slight twilight. | 6 | 0 | — | — |
| | 51 | 1· | 51 | | 6½ | 0 | — | — |
| Total - - | 82 | — | 82 | — | — | 0 | — | — |
| Grand Total - | 126 | — | 106 | — | — | 6 | 3·4 | 5 |

('92) means with spectacles of that power.

## THE LYRIDS OF APRIL 1893.

The splendid weather of the spring months made it not only easy but pleasurable to watch the sky for long periods at what is usually a very inclement period of the year, so that although no very brilliant return of the Lyrids seems to have occurred, several Members of this Section were able to give a good record.

Mr. Denning has published an interesting account of his observations in "Nature" for May 4. He was watching at intervals on the nights of April 18, 20, 21, and in 8½ hours counted 56 meteors, of which 18 were Lyrids. On the 20th the radiant was at 272° + 33°, and on the 21st at 273° + 34°.

On the latter date some brilliant meteors were seen, one being as bright as Venus and leaving a long streak.



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It is curious to find that Mr. Denning's very clearly marked radiant is not shown so distinctly in the observations of some other Members of the Section, though his great experience in meteor observation makes it seem very rash to say anything in the way of dissent. However, it must be told that at Bridgwater two distinct centres of radiation were found, and these were well upheld by the observations of Mr. R. W. Blakeley, at Dewsbury, whose great assistance during the spring the Director is glad to acknowledge, and also to some extent by the few meteors seen by Mr. Ferrington at Shrewsbury.

From these it would seem that there was another shower in progress near $\theta$ Herculis, $267° + 37°$, giving swifter meteors, with a larger proportion of streaks. At Bridgwater, 15 Herculids were seen with nine streaks, and only 10 Lyrids from $276° + 34°$, with two streaks.

Mr. Blakeley's radiants come out at $266° + 37°$ for the Herculids, and at $276° + 34°$ for the true Lyrids, and in this case also the finer shower seems to have been the Herculids.

It may be well to state that in the years 1877, 1878, 1879, 1880, the radiant appeared to the writer to be always at the normal position; but in 1882, when more than usual were seen, it was near $\theta$ Herculis at $268 + 37°$, 26 meteors.

It still remains a question whether there are two distinct showers, or whether they are only branches of one stream.

It is rather strange that several showers should have double radiants; in two or three cases the different appearance of the meteors leads one to suppose that the streams are quite distinct, and in some years one prevails, and in others a different one, or both may appear together, as in the Lyrids of this season.

The hourly number of meteors in April never seemed to rise above 10 or 12, and of these only half were Lyrids at the best time of the shower.

THE AQUARIDS OF MAY 1893.

This most interesting shower is very difficult to observe, for as the radiant does not rise until morning twilight, the meteors do not appear until daybreak. They are, however, so very fine that the observer is repaid if only two or three are seen. This year, in a watch of three hours, on the morning of May 7, only two Aquarids were seen, with splendid streaks about 30° long, and a radiant at $338\frac{1}{2}° - 3\frac{1}{2}°$. Mr. Milligan saw none, though he watched for them.

PERSEIDS OF AUGUST 1893.

This favourite shower was well observed at various stations, and a number of observations of bright meteors sent in, as well as general results and accounts of the shower. More than a thousand meteors were recorded by five or six observers, of which Mr. Blakeley contributed more than 300, which he mapped out of a still larger total. Mr. Milligan saw more than 100, the Director 380, and other Members of the Section added to it, besides which Mr. Denning sent in several reports of his interesting and valuable observations.

The shower was evidently not a remarkable one in any way. The hourly number does not seem to have risen much above 40



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for one observer, even on August 10, and on the other nights of observation, generally about 12 to 15 meteors were seen in the hour. The Perseids themselves far outnumbered the "sporadic" meteors on August 10, but on most other nights were quite in a minority, though it should be added that at Bridgwater the nights of the 9th, 11th, and 12th, were overcast, and probably the Perseids on those dates would approach in number the total for August 10; this is indicated by the results of short watches kept by Mr. Backhouse, for on August 9, 17 meteors out of 19 in about an hour were Perseids, and on August 11, when 13 out of 20, in rather less than an hour, were from this radiant.

A fair number of brilliant meteors were seen, especially by Mr. Backhouse at Sunderland, but perhaps the contemporaneous display of Cygnids produced almost half of them. At any rate, at Bridgwater, a very small proportion of the Perseids were brighter than a first magnitude star, and none of exceptional brilliancy. The very bright Perseids generally end up with a very vivid pale green flash, leaving a streak for some seconds, but none of these were recorded at Bridgwater, and it would not appear that many were seen elsewhere. Meteors of the apparent size of Jupiter and Sirius were fairly abundant. These are generally yellow in colour, and some deep orange.

The attention of several observers was given to the shifting of the radiant point, and the results were fairly accordant and conclusive, although on the maximum dates the radiant seemed to be rather diffuse, and the progression was not so well seen.

The following table will show the results arrived at, and a comparison of the positions found by different observers may be made at a glance.

| Date. | Denning. | Blakeley. | Corder. | Booth and Milligan. |
|---|---|---|---|---|
| | R.A. Dec. | R.A. Dec. | R.A. Dec. | R.A. Dec. |
| Aug. 5 | 39° + 55° | 39° + 54° | — | — |
| „ 8 | 41 + 56 | 42 + 55 | 42 + 46<br>35 + 56 | — |
| „ 9 | 43 + 57 | 44 + 55 | — | 43 + 57 Booth. |
| „ 10 | 45 + 57 | 44 + 56 | 40 + 56½<br>44 + 57⅓<br>47 + 58½ | 45 + 57 Milligan. |
| „ 12 | 48 + 58 | 44 + 55 | — | 48 + 51 Booth. |
| „ 13 | 48 + 58 | — | 48 + 59 | — |
| „ 14 | 49 + 57 | 49 + 55 | 54 + 59<br>55 + 57 | Perhaps Camelids. |
| „ 15 | — | 51½ + 59 | | |
| „ 16 | 52 + 57 | — | — | — |
| „ 18 | 54 + 58 | 54 + 62 | — | — |
| „ 21 | — | — | — | 55 + 57 Milligan. |

The observations of Mr. Denning and Mr. Blakeley, show the movement of the radiant in R.A. very well indeed, though it is curious to note that it appeared almost stationary to Mr. Blakeley from August 9 to 12, at 44° + 55°, whilst at Bridgwater it seemed to change its place very considerably, from 40° + 56½° to



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47° + 58½° during the one night of August 10. This observation was very carefully made, the meteors evidently coming from near η Persei early in the evening, and as certainly from near B.C. Camelopardi later in the night. The Bridgwater radiant at 54° + 59° on August 14 was believed by the observer to indicate a distinct shower of Camelids, the meteors appearing to differ in character; Mr. Denning believes them to have been true Perseids, although it will be seen that the position does not at all agree with those found by Mr. Denning and Mr. Blakeley. The former saw a shower of Camelids on this date at 61° + 60°, and if the position at 54° + 59° had not been very well defined, it might be thought to be a confusion of the two showers of Perseids and Camelids. Several meteors were seen which appeared to be true Perseids, but they were not well observed, and therefore not mapped.

Amongst other observers, Rev. S. J. Johnson, at Bridport, saw a number of Perseids on August 9, and a few on other dates. Mr. J. Wykes, at Birmingham, saw over 30 on August 10. Mr. Milligan at Belfast, had bad weather, but it was clear on August 10, and partly so on August 9, and upwards of 100 meteors were counted, including a brilliant blue rocket-like meteor as bright as ♃ at 9.30 on August 10. Mr. Pope, at Dingwall, was, as usual, unlucky, his station so far north being very unfavourable for astronomical work, and very few meteors were seen. Mr. Davis, at Reading, saw a good many brilliant meteors on different nights, and Rev. W. R. Waugh saw more than 20 Perseids at Portland. Unfortunately also, Mr. Booth was almost prevented from watching by cloudy skies, a few being seen on August 9.

Most observers mention the brilliant and phenomenal lightning seen all over the country on August 9, in many cases the flashes being almost continuous for hours.

Herr J. Plassmann, of Warendorf, sends a list of tracks for August, but unfortunately, the resulting radiants are not marked with sufficient clearness.

## PERSEID SHOWER, 1893.

*Observed at Sunderland and Seaton Carew (Co. Durham).*

| Date and Time of Watching. | Duration in Minutes. | Minutes of Duration corrected for State of Sky. | Hindrance to Visibility. | Mag. (Stellar) visible. | Number of Meteors seen. | Rate per Hour. | Number of Perseids seen. |
|---|---|---|---|---|---|---|---|
| 8 mo. 8: h m h m | | | | | | | |
| 9·44 to 10·21 | 23 | 21 | Twilight; haze and gaslight. | 5½–6½ | 2 | 5·7 | 1 |
| 10·31 „ 11·17 | 19 | 19 | — | — | 7 | 22·1 | 5 |
| 11·30 „ 11·40 | 2 | 2 | Hazy | 6 | 0 | 0 | 0 |
| Total | 44 | 42 | — | — | 9 | 12·9 | 6 |



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| Date and Time of Watching. | Duration in Minutes. | Minutes of Duration corrected for State of Sky. | Hindrance to Visibility. | Mag. (Stellar) visible. | Number of Meteors seen. | Rate per Hour. | Number of Perseids seen. |
|---|---|---|---|---|---|---|---|
| 8 mo. 9: h m h m | | | | | | | |
| 9·52 to 10·5 | 3 | 3 | Twilight | 6–6½ | 1 | 20·0 | 1 |
| 10·35 „ 11·25 | 32 | 32 | — | — | 11 | 20·6 | 11 |
| 11·40 „ 12·40 | 33 | 30 | — | — | 7 | 14·0 | 5 |
| Total | 68 | 65 | — | — | 19 | 17·5 | 17 |
| 8 mo. 10: | | | | | | | |
| 10·0 to 10·35½ | 16½ | 13 | Slight twilight at first | — | 6 | 27·7 | 6 |
| 10·44 „ 10·46 | 2 | 1 | Thin cloud | 5½ | 0 | 0 | 0 |
| 11·2 „ 11·19 | 14 | 11 | Partly thin cloud | 6–7 | 3 | 16·4 | 3 |
| Total | 32½ | 25 | — | — | 9 | 21·6 | 9 |
| 8 mo. 11: | | | | | | | |
| 10·0 to 10·19 | 9 | 8 | Partly thin cloud | 6–7 | 2 | 15·0 | 2 |
| 11·16 „ 11·56 | 15 | 15 | — | — | 8 | 32·0 | 5 |
| 11·58 „ 13·40 | 32½ | 32½ | — | — | 10 | 18·5 | 6 |
| Total | 56½ | 56 | — | — | 20 | 21·4 | 13 |
| *At Seaton Carew.* | | | | | | | |
| 8 mo. 12: | | | | | | | |
| 9·57 to 10·0 | 3 | 3 | Partly thin cloud | — | 1 | 22·2 | 1 |
| 10·50 „ 13·51 | 11 | 10 | — | — | 5 | 30·0 | 1 |
| Total | 14 | 13 | — | — | 6 | 27·7 | 2 |
| *At Seaton Carew.* | | | | | | | |
| 8 mo. 13: | | | | | | | |
| 10·10 to 10·15 | 5 | 5 | — | — | 1 | 12·0 | 0 |
| 11·4 „ 11·23 | 8 | 7 | — | — | 2 | 17·1 | 0 |
| Total | 13 | 12 | — | — | 3 | 15·0 | 0 |
| Grand Total | 228 hrs. 3½ | 213 | — | — | 66 | 18·6 | 47 |

## ORIONIDS, OCTOBER 1893.

Weather either cloudy or foggy during the Orionid period, and almost no observations made. On October 10, a few were seen at Bridgwater, with radiant at 90°+16°. This is a very early date, and shows that there is very little, if any, shifting of this radiant during the period of the shower, and adds proof to the belief that the strong shower of almost similar meteors from



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$\nu$ and $\gamma$ Geminorum seen a few days later in several years, is quite separate from the Orionids. These Geminids were slightly observed on October 22, from 97° + 19°, 4 meteors only.

LEONIDS OF NOVEMBER 1893.

As we are now nearing the maximum display of the Leonids it becomes more important to obtain evidence of the strength of the shower. This year there was not much opportunity on account of cloudy skies. One or two were seen on November 7, and a long watch was kept at Bridgwater on November 12. In the evening none were seen during about two hours, and watching was resumed at $12^h\ 30^m$, but no Leonids appeared until $14^h\ 30^m$, when a very few began to fall. At about $15^h\ 15^m$ they became more numerous, and were indeed the only meteors seen for about 20 minutes, when unfortunately it clouded over completely. Only about a dozen were seen in November, which could possibly have been Leonids, and two centres of divergence were found; one, the true Leonids at 155° + 23°; the other at 152° + 28° may have been the shower from Leo Minor, which has often been noticed at about this date.

From American sources we learn that some brilliant Leonids were seen in that country, and that the shower was unusually strong on dates later than we generally expect it, especially about November 14 and 15.

TAURID AND LEONID SHOWER.

| Time. | O. | Sky. | O'. | Hindrance. | Mag. Vis. | F. | R. | ϑ | Ω |
|---|---|---|---|---|---|---|---|---|---|
| 11 mo. 3: h m h m | | | | | | | | | |
| 10·0 to 10·30 - | 4 | ·8 | 3 | — | — | 0 | 0 | 0 | — |
| 11 mo. 4: | | | | | | | | | |
| 6·44 to 9·11 - | 22 | ·94 | 20·7 | Mist and twilight. | 5½–6½ | 0 | 0 | — | — |
| 9·43 „ 11·10 - | 25 | 1· | 25 | Mist - - | 6½ | 1 | 2·4 | 0 | — |
| 13·50 „ 13·52 - | 2 | 1· | 2 | Auroral light - | — | 0 | — | — | — |
| Total - | 49 | — | 48 | — | — | 1 | 1·25 | 0 | — |
| 11 mo. 5: | | | | | | | | | |
| 6·10 to 7·57 - | 14 | ·8 | 11·2 | Slight twilight and gaslight. | 6–6½ | 0 | 0 | — | — |
| 8·3 „ 11·30 - | 22 | — | 17 | Thin cloud at times. | 6½–7 | 1 | 3·5 | 0 | — |
| 17·53 - - | 2 | ·2 | ·4 | Twilight - | 4½ | 1 | — | 0 | — |
| Total - | 38 | — | 29 | — | — | 2 | 4·1 | 0 | — |
| 11 mo. 6: | | | | | | | | | |
| 6·40 to 7·2 - | 10 | ·9 | 9 | — | 0 | 0 | — | — | — |
| 7·31 „ 7·35 - | 4 | ·6 | 2·4 | — | 0 | 0 | — | — | — |
| 9·30 „ 10·30 - | 11 | ·7 | 7·7 | — | — | 1 | — | 1? | — |
| Total - | 25 | — | 19 | — | — | 1 | 3·2 | 1 | — |



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| Time. | O. | Sky. | O′. | Hindrance. | Mag. Vis. | F. | R. | ♂ | Ω |
|---|---|---|---|---|---|---|---|---|---|
| 11 mo. 7: | | | | | | | | | |
| h m h m | | | | | | | | | |
| 7·25 to 7·40 | 8 | ·6 | 5 | Gaslight | 6–6½ | 1 | — | 1 | — |
| 8·49 „ 9·5 | 14 | 1· | 14 | Partly gaslight | 6½–7 | 0 | — | — | — |
| 10·0 „ 11·20 | 4 | ·5 | 2 | — | — | 0 | — | — | — |
| Total | 26 | — | 21 | — | — | 1 | 2·9 | 1 | — |
| 11 mo. 8: | | | | | | | | | |
| 7·30 to 9·39 | 14 | — | 7·6 | Thin cloud | 6 | 2 | 7·5 | 1 | — |
| 9·39 „ 11·10 | 13 | — | 12·7 | — | — | 2 | 4·6 | 0 | — |
| Total | 27 | — | 20 | — | — | 4 | 12 | 1 | — |
| 11 mo. 9: | | | | | | | | | |
| 8·16 to 8·50 | 10 | ·5 | 5 | — | — | 0 | — | — | — |
| 10·25 | 1 | ·6 | 1 | — | — | 0 | — | — | — |
| Total | 11 | — | 6 | — | — | 0 | 0 | 0 | — |
| Grand Total | 180 | — | 146 | — | — | 9 | 3·7 | 3 | — |
| *At Ayton.* | | | | | | | | | |
| 11 mo. 13: | | | | | | | | | |
| 8·34 to 8·43 | 9 | ·4 | 4 | — | — | 0 | 0 | — | 0 |
| 11 mo. 15: | | | | | | | | | |
| 9·30 to 9·50 | 19 | ·7 | 13·3 | — | — | 0 | — | — | — |
| 10·0 „ 10·39 | 13 | ·9 | 11·7 | — | — | 0 | — | — | — |
| 10·45 „ 11·5 | 4 | ·8 | 3·2 | — | — | 1 | — | — | 0 |
| Total | 36 | — | 28 | — | — | 1 | 2·1 | — | 0 |
| Grand Total | 45 | — | 32 | — | — | 1 | 1·9 | — | 0 |

*Explanation*:—This table shows the principal times of my watch in the recent Taurid and Leonid meteor periods. It is the same as those previously sent. ♂ denotes what I took at the time to be a Taurid, and Ω a Leonid.

All the observations are at Sunderland, except 11 mo. 13, which was at Great Ayton, in Yorkshire.

## TAURIDS OF NOVEMBER 1893.

The true Taurids of November were exceedingly scarce this season, and during a number of watches only seven were seen at Bridgwater, and Mr. Backhouse recorded fewer still. Ths radiant, as usual, was at 61° + 21°.

A large number of brilliant meteors, which are recorded in a special list, were, however, seen at about this time, and especially during the last week of October. These were from a number of different centres, in Cetus, Aries, and Musca, and probably in some years all these have been more or less confused with the Taurids proper, which, however, come a week or two later.



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ANDROMEDES, 1893.

One or two meteors which were directed from near $\gamma$ Andromedæ in the last week of November may have belonged to this shower, but nothing else seems to have been seen of it this year.

GEMINIDS, 1893.

Some evenings during this shower were very clear, but clouds generally came up later when meteors were becoming more abundant. The cold weather and the influenza epidemic also prevented much work at that time, and as the reports show that several other centres were active in Lynx and elsewhere, no very clear account can be given. Mr. Backhouse recorded 37 meteors, of which perhaps 23 were Geminids, including two very brilliant ones. Mr. Milligan was also watching, but considered the Lyncids from about 120 + 40 to be the chief shower.

Mr. Denning tried to arrange for a simultaneous watch between himself at Bristol, Prof. A. S. Herschel, at Slough, and H. Corder, at Bridgwater, but owing to the causes mentioned above very little came of it. Prof. Herschel was the most successful, and he also found a radiant in Lynx, and other meteors were from Castor and near Pollux, but the paths are so scattered that from the small numbers mapped it would not be safe to say exactly where the radiants were this season.

WATCH FOR GEMINIDS, 1893.

| Interval of Watch. | Minutes of Observation. | Area of clear sky. | Minutes of Observation corrected for Sky. | Hindrance to Visibility. | Magnitude of faintest Stars Visible. | Number of all Meteors seen. | Rate per Hour. | Number of Geminids seen. |
|---|---|---|---|---|---|---|---|---|
| *At Torquay.* | | | | | | | | |
| 12 mo. 6: h m h m | | | | | | | | |
| 10·5 to 10·10 - | 5 | ·7 | 3·5 | — | — | 0 | 0 | — |
| 12 mo. 8: | | | | | | | | |
| 5·55 to 6·3 - | 6 | ·8 | 4·8 | Partly thin cloud - | 6–7 | 0 | 0 | — |
| 6·55 „ 7·25 - | 16 | ·8 | 12·8 | „ | 6–7 | 0 | 0 | — |
| 10·9 „ 10·8 - | 8 | ·8 | 6·4 | — | — | 0 | 0 | — |
| Total - - | 30 | — | 24 | — | — | 0 | 0 | — |
| 12 mo. 9: | | | | | | | | |
| 6·45 to 6·55 - | 4 | 1· | 4 | Small area of sky visible. | — | 1 | 15 | 0 |
| 7·26 „ 8·26 - | 32 | 1· | 32 | — | — | 2 | 3·7 | 0 |
| 9·35 „ 10·55 - | 23 | 1· | 23 | — | — | 3 | 7·8 | 3 |
| 11·27 „ 11·46 - | 9 | 1· | 9 | — | — | 1 | 6·7 | — |
| Total - - | 68 | — | 68 | — | — | 7 | 6·2 | — |



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| Interval of Watch. | Minutes of Observation. | Area of clear Sky. | Minutes of Observation corrected for Sky. | Hindrance to Visibility. | Magnitude of faintest Stars visible. | Number of all Meteors seen. | Rate per Hour. | Number of Geminids seen. |
|---|---|---|---|---|---|---|---|---|
| 12 mo. 10: | | | | | | | | |
| h m h m | | | | | | | | |
| 6·24 to 7·52 - | 17 | 1· | 17 | —— | — | 0 | 0 | — |
| 17·6 „ 17·48 - | 26 | ·7, 1·, ·9 | 24 | Auroral light - | 6¾ | 6 | 15·0 | 2 |
| 17·56 „ 18·10 - | 4 | ·5 | 2 | Slight twilight - | 6¼–6 | 0 | 0 | — |
| Total - - | 47 | — | 43 | —— | — | 6 | 8·4 | — |
| 12 mo. 11: | | | | | | | | |
| 5·45 to 5·55 - | 5 | ·9 | 4·5 | —— | — | 0 | 0 | — |
| 8·11 „ 9·26 - | 42 | ·1 | 42 | —— | — | 7 | 10·0 | 6 |
| 10·0 „ 12·18 - | 20 | 1·, ·9 | 19 | —— | — | 1 | 3·2 | 1 |
| Total - - | 67 | — | 65½ | —— | — | 8 | 7·3 | — |
| *At Sunderland.* | | | | | | | | |
| 12 mo. 12: | | | | | | | | |
| 8·52 to 9·56 - | 24 | ·5, 1· | 22·5 | Misty - - - | 6¾ | 3 | 8·0 | 3 |
| 10·26 „ 10·56 - | 12 | 1· | 12 | —— | — | 4 | 20·0 | 2 |
| 11·44 „ 12·58 - | 24 | 1·, ·9, ·4 | 21 | —— | — | 6 | 17·1 | 4 |
| Total - - | 60 | — | 55½ | —— | — | 13 | 14·1 | — |
| 12 mo. 13: | | | | | | | | |
| 9·30 to 9·50 - | 19 | ·9 | 17·1 | —— | — | 3 | 10·6 | 1 |
| 9·59 „ 14¾ - | 9 | ·5, 1· | 6 | —— | — | 0 | 0 | — |
| 18·20 „ 18·35 - | 13 | 1· | 13 | Slight twilight - | 6¾–6½ | 0 | 0 | — |
| Total - - | 41 | — | 36 | —— | — | 3 | 5·0 | — |
| 12 mo. 14: | | | | | | | | |
| 7·30 to 8·5 - | 14 | 1· | 14 | Slight moonlight, and partly thin cloud. | 6–5¼ | 0 | 0 | — |
| 9·36 „ 10·24 - | 17 | — | 17 | Gaslight and partly thin cloud. | 6¼–5¾ | 0 | 0 | — |
| Total - - | 31 | — | 31 | —— | — | 0 | 0 | — |
| Grand Total | 349 | — | 326½ | —— | — | 37 | 6·8 | 22 |



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## List of Meteor Radiants observed in 1892–3.

In the following list details are given of all radiants determined from observations made by Members of the British Astronomical Association, from October 1st 1892, to December 1893.

The first column gives the reference number, and is in continuation of the list in the last two reports of the Section. Each determination has a separate number, although, in the case of important showers, several refer to the same shower.

In some cases the number of meteors constituting a radiant is very inadequate, but care has been taken to exclude positions which were open to serious question.

The column headed "class" is an attempt to separate the meteors into three main divisions: those called "swift," belong to the class of which the Perseids and Leonids are the best known examples, the meteors of which almost invariably leave gaseous streaks in the sky. Some of these are anything but swift, for instance, the May Aquarids, whose motion is slow, but the streaks are extremely fine. Those classed as "quick," are generally short darting meteors, rarely leaving streaks, of which the Geminids are the type. They are generally the commonest of all. Those classed as "slow," contain the Taurids and Andromedes, and are generally dull orange meteors with spark trains, not often leaving streaks; they are generally characterised by long courses. Some, such as the Quadrantids are difficult to describe, coming midway between two divisions, as there is no absolute line between them.

### List of Radiant Points of Meteors, October 1892 to December 1893.

| B.A.A. Ref. No. | Date. | Name. | Radiant. | No. of ψ's. | Class. | Observers. |
|---|---|---|---|---|---|---|
| | 1892. | | ° ° | | | |
| 135 | Oct. - - | Orionids - | 90 + 17 | 3 | Swift - - | B. |
| 136 | „ 17–29 - | Orionids - | 87 + 18 | 9 | Swift - - | C. |
| 137 | „ 17–29 - | Orionids - | 92 + 15 | — | Swift - - | M. |
| 138 | „ - - | γ Geminorum | 98 + 18 | 5 | Swift - - | B. |
| 139 | „ 17–23 - | ξ Geminorum | 96 + 18 | } 22 | Swift - - | C. |
| 140 | „ 17–23 - | ν Geminorum | 99 + 15 | | | |
| 141 | „ 17–23 - | Gemini - | 98 + 11 | | | |
| 142 | „ - - | Arietids - | 37 + 21 | — | Slow - - | B. |
| 143 | „ end - | α Arietis - | 34 + 22 | } 11 | Slow - - | C. |
| 144 | „ end - | Aries - - | 30 + 20 | | | |
| 145 | „ end - | σ Arietis - | 38 + 14 | 5 | Slow - - | C. |
| 146 | „ end - | Aries - - | 40 + 25 | — | Slow - - | M. |
| 147 | Nov. 23 - | Aries - - | 37 + 15 | — | Slow - - | Bh. |
| 148 | „ - | ο Tauri | 49 + 9 | 5 | Slow - - | C. |



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| B.A.A. Ref. No. | Date. | Name. | Radiant. | No. of ψ's. | Class. | Observers. |
|---|---|---|---|---|---|---|
| | 1892. | | ° ° | | | |
| 149 | Oct.-Nov. | - - - | 48 + 23 | 3 | Slow - - | D.B. |
| 150 | „ | α Persei - | 47 + 49 | 10 | Quick - - | C. |
| 151 | „ | Perseus - | 55 + 53 | — | Quick - - | P., C. |
| 152 | „ | Perseus - | 55 + 60 | — | Quick - - | M. |
| 153 | „ | Triangulids - | 30 + 35 | — | Quick - - | M. |
| 154 | „ | Draconids - | 265 + 70 | — | Quick - - | M. |
| 155 | Oct. | Cassiopeia - | 15 + 60 | — | Quick - - | M. |
| 156 | „ - - | δ Cassiopeiæ - | 22 + 59 | — | Quick - - | C. |
| 157 | „ - - | β–ζ Persei - | 51 + 37 | — | Quick - - | C. |
| 158 | „ - - | Orion - - | 79 − 5 | — | - - - | P. |
| 159 | „ - - | Lynx - - | 115 + 47 | — | Swift - - | B., &c. |
| 160 | „ - - | Lynx - - | 140 + 40 | — | Swift - - | C. |
| 161 | „ 29–31 - | Monoceros - | 120 − 7 | 5 | Swift - - | C. |
| 162 | „ 23–29 - | Sextans - | 142 + 11 | 7 | Swift - - | C. |
| 163 | „ 17–23 - | ε Cygni - | 306 + 34 | 8 | Slow - - | C. |
| 164 | - - - | ε Cygni - | 298 + 48 | | | |
| 165 | Nov. - | Taurids - | 65 + 20 | — | Slow - - | M. |
| 166 | „ - - | Taurids - | 60 + 21 | — | Slow - - | P. |
| 167 | „ - - | Taurids - | 60 + 21 | — | Slow - - | Rh. |
| 168 | „ - - | Taurids - | 59 + 21 | 25 | Slow - - | C. |
| 169 | „ - - | Aldebaran - | 73 + 16 | | | |
| 170 | Oct.-Nov. - | Pleiades - | 55 + 24 | 13 | Slow - - | C. |
| 171 | Nov. 19 - | Andromedes - | 17 + 34 | 36 | Slow - - | C. |
| 172 | „ 19 - | Andromedes - | 22 + 34 | | | |
| 173 | „ 19 - | Andromedes - | 33 + 35 | | | |
| 174 | „ 19 - | Andromedes - | 36 + 33 | | | |
| 175 | „ 20 - | Andromedes - | 23 + 38 | | | |
| 176 | „ 26 - | Andromedes - | 29 + 42 | — | Slow - - | Rh. |
| 177 | „ 21–24 - | Andromedes - | 23 + 41 | | | |
| 178 | „ 21–24 - | Andromedes - | 35 + 43 | | | |
| 179 | „ 21–24 - | Andromedes - | 12 + 46 | | | |
| 180 | „ 21–24 - | Andromedes - | 24 + 52 | | | |
| 181 | „ 25 - | Andromedes - | 25 + 45 | — | Slow - - | M. |
| 182 | Nov. 19 - | Leonids - | 153 + 21½ | 4 | Swift - - | C. |
| 183 | „ - - | Cygnus - | 314 + 53 | 6 | Slow - - | C. |
| 184 | „ - - | Cygnus - | 302 + 58 | | | |
| 185 | „ - - | β Ursæ - | 160 + 60 | — | Swift - - | Rh. |
| 186 | „ - - | β Ursæ - | 155 + 58 | 2 | Swift - - | C. |
| 187 | Oct.-Nov. - | κ Ursæ - | 134 + 48 | 4 | Swift - - | C. |



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| | 1892. | | ° ° | | | |
| 188 | Oct.–Nov. | ι Ursæ | 125 + 52 | 4 | Swift | C. |
| 189 | „ | θ Ursæ | 140 + 50 | 3 | Swift | C. |
| 190 | Nov. | Aurigæ | 87 + 39 | — | Quick | Rh. |
| 191 | „ | γ Ceti | 39 + 3 | — | Slow | Rh. |
| 192 | Dec. 9–12 | Geminids, Castor Branch. | 107 + 34 | — | Quick | D. |
| 193 | „ 9 | | 109 + 34 | 40 | Quick | C. |
| 194 | „ 12 | | 110 + 34 | 14 | Quick | M. |
| 195 | „ 1–13 | | 110 + 32 | — | Quick | D. B. |
| 196 | „ 9–12 | Pollux Branch. | 119 + 29 | — | Quick | D. |
| 197 | „ 9–12 | | 117 + 30 | 33 | Quick | C. |
| 198 | „ 9–12 | Geminids | 92 + 35 | — | Quick | C. |
| 199 | Dec. | Geminids | 109 + 30 | — | Quick | M. |
| 200 | „ 9 | | 157 + 45 | 4 | Swift | D. B. |
| 201 | „ 9 | β Taurids | 81 + 30 | 7 | Slow | C., P. |
| 202 | Dec. | Taurids II. | 81 + 22 | 4 | Quick | C. |
| 203 | „ | Taurids II. | 77 + 20 | — | Quick | M. |
| 204 | „ 10–13 | Lynx | 135 + 40 | 12 | Swift | M. |
| 205 | „ 10–13 | β Cephei | 320 + 70 | 2 | Slow | M. |
| 206 | „ 10–13 | β Cephei | 325 + 70 | 2 | Slow | C. |
| 207 | „ 10–13 | Cepheus | 333 + 58 | — | Quick | M. |
| 208 | „ 10–13 | Cepheus | 320 + 70 | — | Quick | C. |
| 209 | Dec. | ψ Cassopeiæ | 25 + 68 | — | Quick | M. |
| | 1893. | | | | | |
| 210 | Jan. 1, $12^h$ to $14^h$. | Quadrantids | 230 + 50 | 30 | Slowish | M. |
| 211 | Jan. 16 | Arcturus | 211 + 20 | 3 | Swift | C. |
| 212 | „ 16–20 | Cepheus | 310 + 72 | 3 | Slow | C. |
| 213 | Feb. | ι Cancri | 130 + 30 | 4 | - | Bl. |
| 214 | „ | o Leonis | 144 + 10 | 3 | - | Bl. |
| 215 | „ | Canes V. | 200 + 37 | 3 | - | Bl. |
| 216 | „ | θ Draconis | 240 + 52 | 3 | - | Bl. |
| 217 | „ | ω Draconis | 261 + 69 | — | - | Bl. |
| 218 | Mar. | β Leonis | 174 + 15 | 5 | Slow | Bl., C. |
| 219 | „ | Coma | 185 + 25 | 3 | Slow | Bl., C. |
| 220 | „ | β–κ Cephei | 305 + 72 | 5 | Slow | Bl. |
| 221 | „ | Cygnus | 312 + 47 | 3 | Slow | Bl., C. |
| 222 | „ | Lyra | 281 + 29 | 4 | Swift | Bl. |
| 223 | „ | ψ Ursæ | 168 + 46 | 3 | Quick | — |
| 224 | April | α Serpentis | 237 + 7 | 6 | Swift | C. |
| 225 | „ 20 | μ–δ Serpentis | 238 − 1 | 3 | Slow | C |



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| | 1893. | | ° ° | | | |
| 226 | April 20 | μ Libræ | 220 − 5 | 5 | Swift | C. |
| 227 | „ 20 | β Libræ | 224 − 13 | 3 | Slow | C. |
| 228 | „ 20 | Lyrids | 272 + 33 | 7 | Swift | D. |
| 229 | „ 21 | Lyrids | 273 + 34 | 8 | Swift | D. |
| 230 | „ 20–21 | Lyrids. | 276 + 34 | — | Swift | Bl. |
| 231 | „ 20–21 | Lyrids | 276 + 34 | 10 | Swift | C. |
| 232 | „ 20–21 | Lyrids | 275 + 32 | — | Swift | F. |
| 233 | „ 20–21 | θ Herculids | 266 + 37 | — | Swift | Bl. |
| 234 | „ 20–21 | θ Herculids | 267 + 37 | 15 | Swift | C. |
| 235 | „ 20–21 | θ Herculids | 265 + 34 | — | Swift | F. |
| 236 | „ 20 | ε–γ Bootis | 218 + 33 | — | Quick | D. |
| 237 | „ 20 | ε–γ Bootis | 220 + 33 | 3 | Quick | C. |
| 238 | „ 21 | Virgo-Bootis | 200 + 9 | — | Quick | D. |
| 239 | April | γ Ursæ Min. | 235 + 69 | — | Quick | Bl. |
| 240 | „ 8 | γ Ursæ Min. | 235 + 67 | 6 | Quick | C. |
| 241 | April | Draco | 275 + 67 | — | Quick | Bl. |
| 242 | „ | Draco | 288 + 68 | 2 | Quick | C. |
| 243 | „ | μ Bootis | 230 + 37 | — | - | Bl. |
| 244 | „ | ξ Bootis | 223 + 20 | 6 | Quick | C. |
| 245 | „ | Canes V. | 204 + 35 | 7 | Slow | C. |
| 246 | „ 13 | ε Ursæ | 192 + 55 | — | - | Bl. |
| 247 | „ 13 | Corona | 238 + 23 | 6 | Quick | C. |
| 248 | „ 13 | γ Herculis | 241 + 19 | | | |
| 249 | „ 18–21 | κ Aquilæ | 296 − 9 | 4 | Swift | C. |
| 250 | „ 20 | Sagitta | 292 + 17 | 1 D'bl. obs. | Swift | D., C. |
| 251 | - - | Aquarids | 338½ − 3½ | — | Swift | C. |
| 252 | - - | Aquila | 295 + 4 | — | Swift | Bl. |
| 253 | - - | Coronids | 234 + 28 | — | Slowish | Bl. |
| 254 | July 17–22 | Lyra | 270 + 41 | 3 | Quick | Bl. |
| 255 | „ 17–22 | Honores | 253 + 44 | 4 | Quick | Bl. |
| 256 | „ 17–22 | Perseids | 45 + 51 | 9 | Swift | Bl. |
| 257 | Aug. 9–12 | Perseids | 44 + 55 | — | Swift | Bl. |
| 258 | „ 9 | Perseids | 43 + 57 | — | Swift | D. B. |
| 259 | „ 9 | Perseids | 43 + 57 | — | Swift | D. |
| 260 | „ 10 | Perseids | 45 + 57 | — | Swift | D. |
| 261 | „ 10 | Perseids | 44 + 57 | — | Swift | C. |
| 262 | „ 10 | Perseids | 45 + 57 | — | Swift | M. |
| 263 | „ 5–16 | Camelids | 61 + 60 | — | Swift | D. |



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| | 1893. | | | | | |
| 264 | Aug. 14–19 - | Camelids - | 58° + 60° | 18 | Swift - - | C. |
| 265 | „ 17 - | Camelids - | 58 + 62 | 5 | Swift - - | Bl. |
| 266 | „ 21 - | Camelids - | 55 + 70 | — | Swift - - | M. |
| 267 | „ 8–19 - | Cygnids - | 290 + 50½ | 30 | Quick, or slow, with streaks | Bl. |
| 268 | „ 14–16 - | Cygnids - | 293 + 53 | 12 | | D.B. |
| 269 | „ 4–18 - | Cygnids - | 292 + 51 | 40 | | C. |
| 270 | Aug. - | Cygnids - | 292 + 53 | 16 | | D. |
| 271 | „ - - | Cygnids - | 292 + 50 | — | | M. |
| 272 | „ - - | η Cephei - | 311 + 62 | 14 | Quick - - | D. |
| 273 | „ 14–19 - | β Cephei - | 317 + 72 | 20 | Quick - - | Bl. |
| 274 | „ 14–19 - | Cepheus - | 300 + 63 | 8 | Quick - - | Bl. |
| 275 | „ 8–18 - | η Cephei - | 305 + 62 | 9 | Quick - - | C. |
| 276 | „ 8 - | κ Cephei - | 310 + 79 | 12 | Quick - - | C. |
| 277 | „ 4–16 - | κ Cephei - | 310 + 77 | 6 | Quick - - | D. |
| 278 | Aug. - | κ-γ Cephei - | 329 + 83 | 3 | Quick - - | Bl. |
| 279 | „ 14 - | δ Equulei - | 317 + 9½ | 7 | Quick - - | Bl. |
| 280 | „ 14 - | δ Equulei - | 315 + 8 | — | Quick - - | C. |
| 281 | Aug. - | θ Piscium - | 349 + 7½ | 4 | Quick - - | Bl. |
| 282 | „ - - | ε Piscium - | 11 + 4 | 3 | Quick - - | Bl. |
| 283 | „ - - | γ Piscium - | 347 ± 0 | 3 | Quick - - | Bl. |
| 284 | „ - - | γ Piscium - | 347 ± 0 | 6 | Quick - - | D. |
| 285 | „ - - | γ Piscium - | 347 ± 0 | 6 | Quick - - | C. |
| 286 | „ - - | Piscids - | 351 + 3 | — | Quick - - | C. |
| 287 | „ - - | Piscids - | 347 − 7 | — | Quick - - | C. |
| 288 | Aug. 13–15 - | η Aquarii - | 337 − 2 | 8 | Quick - - | C. |
| 289 | „ 12 - | η Aquarii - | 339 − 3 | 4 | Quick - - | Bl. |
| 290 | „ 12 - | β Aquarii - | 322 − 5 | 5 | Quick - - | Bl. |
| 291 | „ 18 - | α Aquarii - | 325 − 1 | 4 | Quick - - | C. |
| 292 | Aug. - | Capricornids - | 298 − 15 | 9 | Quick - - | C. |
| 293 | „ - - | Capricornids - | 314 − 14 | | | |
| 294 | „ 18 - | Capricornids - | 313 − 8 | 6 | Quick - - | Bl. |
| 295 | „ 10 - | Capricornids - | 304 − 13 | 1 D'bl. obs. | Slow - - | D., C. |
| 296 | „ 12 - | Lacertids - | 337 + 49 | 8 | Quick - - | Bl. |
| 297 | „ 10–21 - | Lacertids - | 335 + 49 | — | Quick - - | M. |
| 298 | „ 15 - | π Pegasi - | 328 + 31 | 4 | Quick - - | Bl. |
| 299 | „ 17 - | Pegasus - | 336 + 20 | 5 | Quick - - | Bl. |
| 300 | Aug. - | δ Aurigæ - | 83 + 61 | 6 | Swift - - | C. |
| 301 | „ - - | ε Persei - | 55 + 36 | 4 | Swift - - | C. |



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| | 1893. | | | | | |
| 302 | Aug. 16 - | α–β Persei - | 48° + 44° | — | Swift - - | D |
| 303 | Aug. - - | α–β Persei - | 47 + 45 | — | Swift - - | M. |
| 304 | „ - - | α–β Persei - | 48 + 43 | 4 | Swift - - | C. |
| 305 | Aug. 16 - | α–β Persei - | 48 + 51 | 3 | Swift - - | D.B. |
| 306 | „ 10 - | δ Persei - | 54 + 57 | 4 | Swift - - | Bl. |
| 307 | „ 19 - | Musca - | 47 + 28 | 3 | Swift - - | Bl. |
| 308 | „ 8–15 - | δ Ursæ Min. - | 280 + 84 | 5 | Quick - - | C. |
| 309 | „ 13 - | ζ Draconis - | 270 + 64 | 6 | Quick - - | C. |
| 310 | Aug. - - | δ Cygni - | 291 + 43 | 10 | Quick - - | C. |
| 311 | „ - - | γ Cygni - | 304 + 39 | | | |
| 312 | „ - - | ο Cygni - | 302 + 46 | | | |
| 313 | „ - - | Psalterium - | 59 ± 0 | 3 | Swift - - | C. |
| 314 | Sept. 11 - | Cassiopeia - | 359 + 62 | 5 | Quick - - | C. |
| 315 | „ 3–11 - | δ Piscium - | 6 + 8 | 4 | Slowish - - | C. |
| 316 | „ 8 - | Aurigæ - | 92 + 50 | 6 | Swift - - | C. |
| 317 | Sept. - | γ Ursæ Min. - | 230 + 68 | 6 | Quick - - | C. |
| 318 | „ - - | κ Cephei - | 290 + 81 | 4 | Quick - - | C. |
| 319 | Oct. 10–19 - | Orionids - | 91 + 16 | 8 | Swift - - | C. |
| 320 | „ 22 - | γ Geminorum | 97 + 19 | 4 | Swift - - | C. |
| 321 | Oct. - - | Lacerta - | 323 + 53 | 5 | Slow - - | C. |
| 322 | Oct.–Nov. - | α Persei - | 50 + 48 | 8 | Quick - - | C. |
| 323 | Oct. - - | Cassiopeia - | 20 + 64 | 4 | Quick - - | C. |
| 324 | „ - - | Custos - | 49 + 74 | 6 | Quick - - | C. |
| 325 | Sept.–Oct. - | Polarids - | 350 + 86 | 6 | Quick - - | C. |
| 326 | Oct. - - | γ Pegasi - | 4 + 14 | 5 | Slow - - | C. |
| 327 | „ - - | β Arietis - | 30 + 18 | 8 | Slow - - | C. |
| 328 | „ - - | ξ¹ Ceti - | 31 + 9 | 22 | Slow - - | C. |
| 329 | „ - - | γ Coti - - | 39 + 4 | | | |
| 330 | Oct.–Nov. - | Muscids - | 44 + 21 | 28 | Slow - - | C. |
| 331 | „ - | Arietids - | 50 + 17 | | | |
| 332 | „ - | ƒ Tauri - | 49 + 14 | | | |
| 333 | Nov. - - | Taurids - | 61 + 21 | 7 | Slow - - | C. |
| 334 | Nov. 13, &c. | Pleiades - | 53 + 24 | 4 | Slow - - | C. |
| 335 | „ „ - | Leonids - | 155 + 23 | 12 | Swift - - | C. |
| 336 | „ „ - | Leo Minor. - | 152 + 28 | | | |
| 337 | „ „ - | Cancrids - | 117 + 14 | 8 | Swift - - | C. |
| 338 | „ „ - | Cancrids - | 126 + 12 | | | |
| 339 | „ „ - | ε Ursæ - | 131 + 51 | — | Swift - - | C. |
| 340 | „ „ - | λ Ursæ - | 153 + 48 | — | Quick - - | C. |



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| | 1893. | | ° ° | | | |
| 341 | Nov. 13, &c. | 29 Ursæ - | 140 + 73 | — | Quick - - | C. |
| 342 | „ 8–10 - | Lynx - - | 100 + 55 | — | Quick - - | M. |
| 343 | Dec. 12 - | Lynx - - | 120 + 40 | 10 | Quick - - | C. |
| 344 | „ 11 - | Geminids - | 109 + 33 | — | Quick - - | C. |
| 345 | „ 11 - | Pollux - | 122 + 26 | — | Quick - - | C. |
| 346 | „ 11 - | Lynx - - | 142 + 37½ | — | Quick - - | C. |

Observers.—B. = T. W. BACKHOUSE. Bl. = E. R. BLAKELEY.
C. = HY. CORDER. D. = W. F. DENNING.
D. B. = DAVID BOOTH. F. = F. H. FERRINGTON.
M. = W. H. MILLIGAN. P. = J. T. POPE
Rh. = J. RHEDEN.

## BRIGHT METEORS OBSERVED BY MEMBERS OF THE BRITISH ASTRONOMICAL ASSOCIATION.

| Date. | Time. | — | — |
|---|---|---|---|
| 1892. | h m | | |
| Oct. 17 - | 9 35 | 3 × ♀ | From 87° + 37° to 220° + 75°, 3 secs. Pear-shaped, with short train, no streak.—J. T. POPE. |
| „ 18 - | 8 45 Dublin time. | ½ ☾ | From head of Draco, under Vega, disappearing under β-γ Lyræ, nearly equal moon in size, like electric light.—G. C. BRUTON, Galley Head, co. Cork. |
| „ 18 - | 10 20 | ♃ | From ♯ (0·23) Ur. Maj. to 1° N. of κ Drac., disappeared near ι Drac. 30° 1·5 secs. Yellow with green to blue streak, Orionid.—T. W. BACKHOUSE. |
| - | 15 50 | Sirius | Yellow streak. ξ Geminorum, radiant. Quick.—H. C. |
| „ 25 - | 6 33 | ♀ | From 349° + 25° to 303° + 11°, slowish, 5 secs. Long streak, slightly bluish.—G. T. DAVIS. |
| „ 29 - | 11 9¢ | 6 | With 4½-in. refractor. Left bright green streak for 1 secs., at first straight and 50″ broad, became zigzag. T. W. B. |
| Nov. 22 - | 6 53 | 3 | 20° + 48° to 25° + 45°, 25 secs. Large nebulous flash, curious.—J. T. P. |
| „ 25 - | 7 50 | ♀ | 60° + 33° to 75° + 18°, 1 sec, bluish white.—J. T. P. |
| Dec. 9 - | 8 9 | >1 | 71° + 16½° to 62° + 10°. Quick, pale green, leaving a streak. Geminid.—H. C. |
| „ 9 - | 12 22 | ♃ | Geminid.—T. W. B. |
| „ 12 - | 11 13 | ♀ | Geminid, from δ Androm., disappearing near ι And., 2 secs. Whitish, then bright green, faint streak.—T. W. B. |
| „ 13 - | 12 27 | ♃ | Ursid., from 85° + 12° to 5° beyond, 1° N. of λ Tauri 12°. Quick, faint streak, orange.—T. W. B. |
| „ 14 - | 7 14 | 2 | From near θ Gem. to under Aldebaran, remarkable for very fine crimson streak.—G. YOUNG, Craigie, Perth. |



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| Date. | Time. | —— | —— |
|---|---|---|---|
| 1893. | h m | | |
| Jan. 4 - | 6 30 | ( | Fell in N.E. Very brilliant colours, changing blue to red, white, purple, &c., bursting with bright flame.—H. FILMER. |
| „ 4 - | 6 29 | 2× ♃ | From 40° + 45° to 44° + 20°. This brilliant meteor, probably a Quadrantid.—E. R. B. |
| „ 4 - | 6 30 | ( | From E. of Dublin, with streak as far as Polaris, equal full moon, bursting, remarkable colours.—Per MISS E. BROWN, Moville. |
| „ 13 - | 3 23 Dublin. | ⊙ | From direction of Corona, 2 secs., dazzling radiance, no streak.—REV. RUNSIE CRAIG, F.R.A.S., Londonderry. |
| „ 18 - | 8 45 | >♀ | From 4° above Castor, ending midways, γ Gem.—Sirius, 2 secs. Orange, with broad red train.—J. W. MEARES, Chelmsford. |
| Mar. 7 - | 7 5 | ♃ | Slow. Greenish.—H. C. |
| „ 11 - | 13 13 | >1 | 340°+82½° to 6°+73½°, rather slow. Radiant 213°+53°.—W. F. D. |
| „ 19 - | 8 46 | Sirius | From near α Canum to 2° beyond 73 Leonis. Swift, slight train.—G. T. D. |
| „ 21 - | 7 39 | ♀ | From α Monoc to between κ-β Orionis, 3 secs. Bright as moon, yellow, no streak.—G. B. LONGSTAFF, Putney. |
| Apr. 3 - | 10 23 | >♀ | From 12°+72° to 9°+59°. 5′ in diam. 4½ secs. Rather slow, golden yellow, slight streak.—G. T. D. |
| „ 15 - | 9 52 | >♃ | From 112° + 27° to 126° + 1°. Rather swift, train of sparks; another brighter just before it.—G. T. D. |
| „ 20 - | 12 22 | Sirius | Swift, yellow streak. Lyrid.—E. R. B. |
| „ 20 - | 13 38 | ♃ | Swift, streak. Lyrid.—E. R. B. |
| „ 20 - | 13 55 | ♃ | Swift, streak, green. Lyrid.—E. R. B. |
| „ 20 - | 14 34 | 2× ♃ | Slowish, 2½ secs. Green. Slight train.—E. R. B. |
| „ 21 - | 12 8 | ♃ | From 270° + 44° to 268° + 49½°, 6° slow. Streak. Lyrid. W. F. D. |
| „ 21 - | 12 24 | ♀ | From 236° + 30° to 207° + 18°, 30°, slow. Bright, streak. Lyrid.—W. F. D. |
| „ 21 - | 13 26 | [>1 | From 292° + 67° to 387° + 69°. 6°. Swift, streak. Radiant, 263° + 61°.—W. F. D. |
| „ 22 - | 10 38 | >♃ | Rather swift, streak and train. 2 secs. Yellow, green. —E. R. B. |
| May 1 - | 9 49 | Sirius | White, with orange train and flakes of fire, from Libra. —H. C. |
| „ 9 - | 10 25 | — | Meteor falling from Ursa, and suddenly changed its course, going off at a sharp angle.—J. PRESTON, Birstall. |
| „ 9 - | 11 21 | >♃ | In Corona and Hercules. Virginid.—W. F. D. |
| „ 13 - | 10 40 | 1 | From 235° + 12° to 212° + 7°. 3 secs. Leaving streak for 1 sec.—G. F. D. |
| „ 13 - | 12 23½ | ½( | Near ν Cygni to below λ Andr. 3½ secs. 1st mag. to ½ of ( green, slightly pear-shaped.—REV. S. J. JOHNSON, Bridport. |
| June 14 - | 10 0 | ♃ | From about 8° or 10° below Arcturus, to near Regulus. Short train of sparks. 3 or 4 secs. Greenish.—J. E. CLARK, York. |



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| Date. | Time. | — | —— |
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| 1893. | h m | | |
| July 13 - | 13 6 | ♃ | From 15° + 38° to 144° + 19°. Train; nucleus disappearing as a stream of sparks. Radiant? near ε Ursæ.—W. F. D. |
| Aug. 2 - | 10 40 | ♃ | From 40° + 55° to 330° + 66°. 0·5 sec. Train, and bright streak.—J. T. P. |
| „ 8 - | 9 30 | ♃ | From 297½° − 5° to 298° − 13°. Swift, slight trail, fading instantly.—G. T. D. |
| „ 8 - | 11 14 | ♃ | A very fine meteor. Perseid.—T. W. B. |
| „ 8 - | 11 25 | ♃ | Perseid.—W. F. D. |
| „ 9 - | 12 2 | ♀ | A magnificent meteor. Perseid.—T. W. B. |
| „ 9 - | 12 38 | >♃ | From 360° + 9° to 35° + 19. Aquarid.—E. R. B. |
| „ 10 - | 9 30 | ♃ | Large blue rocket-like meteor in cast.—W. H. MILLIGAN, Belfast. |
| „ 10 - | 9 50 | ♀ | Leaving streak of great brilliancy for 2 secs., becoming slightly curved.—J. WYKES, Birmingham. |
| „ 10 - | 9 30 | ♃ | From 253½° + 10° to 246° − 7°. Moderate speed. Long streak.—G. T. D. |
| „ 10 - | 9 45 | Sirius | From 355°+15½° to 342°−2°. Slowish, very long streak, remaining visible 10 or 12 secs.—G. T. D. |
| „ 10 - | 10 10 | ♀ | Equal Venus at her brightest; very magnificent. Perseid.—T. W. B. |
| „ 10 - | 11 43 | ♀ | Perseid.—W. F. D. |
| „ 10 - | 11 56 | ♃ | Perseid.—W. F. D. |
| „ 10 - | 13 24 | >♃ | Perseid, leaving bright streak. From 41° + 31° to 41° + 19°.—E. R. B. |
| „ 10 - | 14 55 | ♀ | Perseid, leaving splendid broad streak for 7 secs. From 44° + 40° to 43° + 28°.—E. R. B. |
| „ 11 - | 11 28 | Sirius | A beautiful meteor. Perseid. Others = ♀ were seen on this date at 12.11 and 12.44½; both Perseids.—T. W. B. |
| „ 12 - | 11 33 | >♃ | Apparently stationary at about 358° + 3° in Pisces.—E. R. B. |
| „ 13 - | 8 0 | >♀ | Falling from near zenith in S.S.E.; seen also in Somersetshire and Dorset, bursting into two pieces.—R. H. CARY, Mounts Bay. |
| „ 13 - | 9 40 | ♀ | Flash at 88° + 52°, leaving streak, possibly the flash of a Cygnid.—H. C. |
| „ 13 - | 10 2 | ♀ | From 334° + 17° to 337½° + 11°. Bluish white, with reddish streak. Cygnid.—H. C. |
| „ 13 - | 10 53 | Sirius | From 1° + 54° to 10° + 49°. Bluish white, with streak. Cygnid.—H. C. |
| „ 13 - | 13 5 | ♃ | From 338½° + 27° to 347° + 19½°. Radiant, 271° + 48°.—W. F. D. |
| „ 14 - | 9 27 | ♀ | Bluish, with orange streak. Cygnid.—H. C. |
| „ 14 - | 10 44 | Sirius | Pear-shaped. Bluish white, leaving slight streak. γ Piscium.—H. C. |



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| Date. | Time. | —— | —— |
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| 1893. | h m | | |
| Aug. 14 - | 13 39 | 4 | From 359° + 14° to 310° + 27½°. From Eridanus.—W. F. D. |
| „ 15 - | 9 35 | ♀ | In a line between β Cass. and β Androm. Silvery white, breaking into sparks. ?Cepheid.—MISS E. BROWN. |
| „ 15 - | 10 59 | >4 | From 57° + 40° to 45° + 28°. Commencing as 1st mag. and flashing out, oscillatory motion. Cepheid.—E. R. B. |
| „ 15 - | 12 59 | ♀ | In Delphinus. Cygnid.—W. F. D. |
| „ 15 - | 13 40 | 4 | Cygnid.—W. F. D. |
| „ 15 - | 13 55 | ♀ | Cygnid.—W. F. D. |
| „ 17 - | 9 34 | 4 | From 328°+28° to 340°+8°. Moderate swift. Vaporous streak for 5 or 6 secs.—G. T. D. |
| „ 17 - | 9 38 | 4 | Flash about 3° S. of γ Pegasi. Perhaps end flash of a Cygnid.—H. C. |
| „ 17 - | 11 32½ | 4 | From 30° + 34° to 21° + 14°. Camelid.—E. R. B. |
| Sept. 4 - | 9 25½ | >♂ | 8° beneath ε Aquarii, shot diagonally S.W., short course. Colour greenish red.—REV. J. S. JOHNSON, Melplash. |
| „ 4 - | 9 40 | >1 | From 338° − 5° to 336° − 19°. Moderately swift, slight trail.—G. T. D. |
| „ 7 - | 9 36 | ♀ | From 120° + 55° to 150° + 50°. Very swift, slight trail.—G. T. D. |
| „ 7 - | 10 16 | 4 | From direction of γ Pegasi to θ Ceti. Very swift.—G. T. D. |
| „ 17 - | 10 30 | 2 | From north of Perseus to about 76° + 50°, when path was deflected at a right angle towards Ursa.—H. J. TOWNSHEND, Leeds. |
| „ 19 - | 8 30 | 4 | From between Cepheus and Draco, in line between Vega and N. of 50 Cass. Slow. Golden yellow.—S. L. FLETCHER, Buxton. |
| Oct. 1 - | 9 40 | ♀ | From 160° + 70° to 137° + 46°. Slow. Vivid green, with short red train and flashes of fire at end. Radiant Draco.—H. C. |
| „ 26 - | 11 14 | 4 | From between β Ceti and γ Pegasi. Course 15° or 20°. Greenish colour. Duration, 1·1 sec.—T. W. B. |
| „ 29 - | 7 33 | 4 | From below α Androm. to Altair, 2·5 secs. Fine granular streak for 2 secs., from Aries.—J. E. C. |
| „ 30 - | 6 30 | 4 | From 30° + 23° to 344° + 17°. Rather slow, train and long streak. Bluish in colour. Probably from δ Arietis.—H. C. |
| „ 30 - | 9 38 | 4 | Directed from 21° + 16°, ending at 353° − 8°. Course, about 20°. Slowish, 1·4 secs. Bright streak or train slightly sparkling.—T. W. B., London. |
| „ 31 - | 8 27 | 4 | From between Capella and α Persei, crossed α Ursæ and ended at δ Ursæ. Began as faint streak, and developed a yellow nucleus. Taurid.—C. NAPIER CLARK, Southport. |



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| Date. | Time. | — | — |
|---|---|---|---|
| 1893. | h m | | |
| Nov. 3 - | 5 59 | >1 | From between $\alpha$ and $\beta$ Pegasi to northern part of Sagittarius. Very slow. Reddish orange. Train.—G. B. L. |
| „ 4 - | 11 30 | ½ | From $\epsilon$ Cass. to $\zeta$ Draconis. Very swift. Bluish white, with brilliant streak.—C. N. C. |
| „ 12 - | 6 50 | >½ | From 347° + 7° to 325° + 6°. 10 to 12 secs. Broad greenish streak, and train of red, green, and yellow sparks.—H. J. T. |
| „ 12 - | 8 40 | ½ | From 22° + 62° to 260° + 65°. Slow. Yellowish orange. Fine streak. Taurid, or from near $\pi$ Orionis.—H. C. |
| „ 12 - | 10 9 | 3×½ | From 345° + 20° to 300° + 15°. 2 secs. Faint at first, rapidly brightening through orange to deep blue, and crumbling to a greenish fiery cloud.—F. J. WARDALE, Knebworth. |
| „ 12 - | 6 53 | 1 | From 81½° + 42° to 113°+50½°. Very very slow. 4 secs. Radiant 40° + 6°.—W. F. D. |
| Dec. 1 - | 9 48 | >½ | From near $\zeta$ Persei to $\beta$ Pegasi 5 secs. Long train of sparks.—G. P. D. |
| „ 10 - | 16½ | =½ | From 21hrs + 45° to 19·30° + 28°. White with fluctuating light, duration, about 4 secs. |
| „ 11 - | 8 25 | ♀ | First seen near $\xi$ Cass. passed $\iota$ and $\rho$ Pegasi going 4° further. Bright streak, red in colour. Meteor green at first, changing to bright blue, and fading to yellow. Quick, duration 2·7 secs. Most magnificent.—T. W. B. Torquay. |
| „ 24 - | 11 42 | >Sirius | Parallel with $\beta$ and $\alpha$ Androm., ending 3° sp. $\alpha$. Course seen 10°. Duration, 5 secs. Train or streak.—T. W. B. |
| „ 25 - | 5 25 | =Sirius | Directed from ½($\zeta$ 15) Draconis disappeared ½($\zeta$-$\eta$) Ursæ Maj. Course about 5°. Slow, 1 sec. Faint train, reddish.—T. W. B. |

Observers.—T. W. B. = T. W. BACKHOUSE. E. R. B. = E. R. BLAKELEY.
C. N. C. = C. NAPIER CLARK. H. C. = H. CORDER.
G. T. D. = G. T. DAVIS. W. F. D. = W. F. DENNING.
G. B. L. = G. B. LONGSTAFF. J. T. P. = J. T. POPE.
H. J. T. = H. J. TOWNSHEND.

## HEIGHTS AND RADIANTS OF METEORS, 1892–93.

The interesting details in the following table have been computed by Mr. W. F. Denning, and he has very kindly placed them at my disposal for insertion in the present report. The average heights of the 15 meteors are as follows:—

Mean height at beginning - - 73·8 miles.
Mean height at ending - - 45·6 „
Mean length of observed path - 47·1 „



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## HEIGHTS AND RADIANTS OF METEORS, 1892–93.

| Date. | Time. | Mag. | Height at Beginning. | Height at Ending. | Length of observed Path. | Earth Point. | Radiant Point. | | | Observer. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Position. | Azim. W. of S. | Alt. | |
| 1892. | h m | | | | Miles. | | ° ° | ° | ° | |
| Dec. 9 | 7 39 | 1 | 91 miles, Ilford, Kent. | 57 miles, Whitchurch, Hants. | 75 | Totnes | 103 + 38 (Geminid) | 244 | 28 | H. Corder. W. F. Denning. "H. W. M." |
| | 7 39 | 1 | | | | | | | | |
| | 7 30? | | | | | | | | | |
| Dec. 12 | 10 51¾ | >1 | 60 miles, Hungerford. | 36 miles, Dauntsey, Chippenham. | 31 | River Severn, S.W. of Chepstow. | 111 + 35 (Geminid) | 278 | 52 | A.S. Herschel H. Corder. W. F. Denning. |
| | 10 55? | 1 | | | | | | | | |
| | 10 51 | >1 | | | | | | | | |
| Dec. 12 | 11 20 | 2 | 85 miles, Bristol Channel. 5 miles N. of Lynmouth. | 44 miles, Bristol Channel. Lat. 51° 25′ N Lng. 4° 23′ W | 50 | In sea, 10 miles S. of Milford Haven. | 111 + 34 (Geminid) | 284 | 55 | H. Corder. W. F. Denning. |
| | 11 20 | 2 | | | | | | | | |
| 1893. | | | | | | | | | | |
| Apr. 20 | 11 56 | 3 | 67 miles, Witney, Oxon. | 48 miles, Banbury. | 28 | Loughborough. | 198 + 5 (Virginid) | 11 | 43 | A.S. Herschel W. F. Denning. |
| | 11 56 | 1 | | | | | | | | |
| Apr. 20 | 12 39½ | 2 | 75 miles, Winchester. | 68 miles, Wimborne, Dorset. | 35 | — | 314 + 27 (Cygnid) | 241 | 11 | A.S. Herschel. W. F. Denning. |
| Apr. 20 | 12 44 | 4 | 77 miles, E. of Bath. | 68 miles, S. of Bristol. | 23 | St. George's Channel. | 292 + 17 (Sagittid) | 271 | 23 | H. Corder. W. F. Denning. |
| | 12 44 | 3 | | | | | | | | |
| Apr. 21 | 13 38 | 3 | 62 miles, English Channel, off Portland. | 45 miles, Blandford, Dorset. | 37 | Evesham | 226 − 11 (Librid) | 6 | 27 | H. Corder. W. F. Denning. |
| | 13 38 | 5 | | | | | | | | |
| Apr. 21 | 15 15 | 3 | 80 miles, Trowbridge. | 65 miles, Porkskewet, Monmouth. | 33 | S.W. of Bardsey Island. | 299 ± 0 (Aquilid) | 310 | 27 | H. Corder. W. F. Denning. |
| | 15 16 | 2 | | | | | | | | |
| May 9 | 11 21 | ½ | 76 miles. 8 miles, E. of Bridport. | 40 miles, Corsham, Bath. | 54 | 6 miles E. of Cheltenham. | 202 + 6 (Virginid) | 20 | 42 | S.A. Saunder. W. F. Denning. |
| | 11 21 | >½ | | | | | | | | |
| Aug. 10 | 11 0 | 1 | 38 miles, Alton, Hants. | 23 miles, Wallingford, Berks. | 35 | Daventry, Northamptonshire. | 304 − 13 (Capricornid) | 358 | 25 | H. Corder. W. F. Denning. |
| | 11 | 1 | | | | | | | | |
| Aug. 10 | 11 55 | 1 | 107 miles, Drayton, Shropshire. | 60 miles, Llanbadarn, Radnor. | 69 | Kidwelly, Caermarthen. | 43 + 59 (Perseid) | 225 | 43 | H. Corder. W. F. Denning. |
| | 11 56 | ½ | | | | | | | | |
| Aug. 14 | 11 0 | 1 | 60 miles. 7 miles S. of Bath. Fell vertically. | 45 miles. | 15 | 3 miles S. of Trowbridge. | 294 + 51 (Cygnid) | 92 | 83 | H. Corder. W. F. Denning. |
| | 11 0 | 1 | | | | | | | | |
| Aug. 15 | 11 58 | ½ | 58 miles, Northampton. | 21 miles, High Wycombe, Bucks. | 61 | Guildford, Surrey. | 186 + 74 (κ Draconid) | 166 | 37 | H. Corder. W. F. Denning. |
| | 11 57 | ½ | | | | | | | | |
| Oct. 1* | 9 40 | Fireball. | 105 miles, near Southport. | 28 miles, Newcastle, Staff. | 93 | Near Stafford, | 265 + 65 (ζ Draconid) | 139 | 50 | H. Corder and others. |
| Nov. 12 | 6 50 | ½ | 66 miles, "The Wash," off Norfolk. | 36 miles, Bakewell, Derbyshire. | 91 | Irish Sea, Lat. 52° 36 N Lng. 4° 30′ W | 40 + 6 (Cetid) | 286 | 19 | H. J. Townshend. W. F. Denning. |
| | 6 53 | 1 | | | | | | | | |



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# SECTION FOR THE OBSERVATION

OF

# VARIABLE STARS.

DIRECTOR.—J. E. GORE, F.R.A.S., M.R.I.A.

## REPORT OF THE SECTION, 1892—93.

The work of the section has been chiefly directed to a search for "new" or "temporary" stars in the region of the Milky Way, the discovery of new variable stars, and the observation of known variable stars of which further observations seemed desirable.

The search for "new" stars has not yet produced any result, although one or two "false alarms" were reported to the Director.

Several new variable stars of short period have been discovered by Mr. A. W. Roberts in the southern hemisphere, and the variability of some of these has been confirmed in America. Mr. Roberts' observations have already been published in the "Journal."

The following have joined the section:—

Miss E. BROWN.
DAVID BOOTH
T. R. CLAPHAM, F.R.A.S
HENRY CORDER.
W. E. JACKSON, F.R.A.S.
Lt.-Col. MARKWICK, F.R.A.S.
A. B. P. MEE, F.R.A.S.
G. W. MIDDLETON.
Rev. A. E. BRISCOE OWEN, M.A.
Prof. JOAN DE MORAES PEREIRA, Azores.
J. PLASSMANN.
J. T. POPE.
Prof. O. F. RIGGE, St. Louis (U.S.A.).
A. W. ROBERTS, F.R.A.S., South Africa.
WALTER SANG.
M. D. SEVERN.
Rev. W. R. WAUGH, F.R.A.S.
W. HALE WHITE.
J. T. WOOD.

The following are observations made by some of the Members.



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## I.

## Observations of Variable Stars in 1893.

By HENRY CORDER.

*R Andromedæ.*—Maximum January 23, 1893, magnitude 6·2; 10 observations. Minimum November 1, 1893, magnitude 12; 24 observations.

*R Geminorum.*—Maximum in June? when near sun. Became invisible with 6½ in. in December 1893; 6 observations.

*S Orionis.*—Maximum 8·5 m., December 1. Became invisible end of March; 14 observations.

*R Leonis.*—Maximum when near sun. Minimum February 1, about 10 magnitude; 20 observations.

*R Draconis.*—Maximum May 8, magnitude 7·75; 4 observations.

*R Aurigæ.*—Maximum February 14, magnitude 7·25. Invisible August—October. Minimum September 15; 17 observations.

*U Orionis.*—Maximum, February 4; magnitude 6·4. Minimum about September 15; 12th magnitude; 25 observations. Rise slow for about three months, of about 2 magnitudes, then very rapid, and a rise of three magnitudes in three weeks. Total increase four months, decrease seven months, with stationary period at minimum.

*Mira Ceti.*—Maximum either very faint or behind its time when near sun. Minimum November 25, 9th magnitude.

*T Cassiopeiæ.*—Maximum February 20, 7th magnitude. Minimum August 15, 11·5 magnitude; 18 observations.

*S Cassiopeiæ.*—Maximum April 7, 8·5 magnitude. Invisible in November and December; 10 observations.

*T Ursæ.*—Maximum April 1, 7·75 magnitude, and December 15. Minimum September 7, 12·5 magnitude; 20 observations.

*S Ursæ.*—Maximum May 3, 7.75 magnitude and December 30. Minimum October 1, 11·5 magnitude; 18 observations.

*R Ursæ.*—Maximum October 3, 7·75 magnitude. Minimum, invisible about June 10; 20 observations.

*U Cygni.*—Maximum about January 1, 7·5 magnitude. Minimum September 10, 11·75; 20 observations.

*χ Cygni.*—Maximum November 10, 4·5 magnitude. Very rapid rise of 3½ magnitudes in October. Minimum in May? 18 observations.

*Z Cygni.*—Maximum January 7? 8·5 magnitude and 8 magnitude or less, September 10. Minimum 12th magnitude? for two months, April, May; 20 observations.

*R Serpentis.*—Maximum October 10. Invisible in May or June; 13 observations.

*R Aquilæ.*—August 7, 6 magnitude, followed by a rapid fall to September 9.



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*T Herculis.*—8·25 magnitude for a month, November 25,—December 25; 5 observations.

*S Coronæ.* — April 7, 6·5 magnitude, maximum; 13 observations.

*R Coronæ.*—5·75 magnitude from January 25 to April 1; then about 6th magnitude until December, when a rapid decrease set in; 27 observations.

*R Cassiopeiæ.*—Maximum May 28? 8·5 magnitude. At minimum for a long time of 11 magnitude; 20 observations.

*R Cygni.*—Maximum April 15, 7·75 magnitude. Minimum after December 1. Rapid rise of 5 magnitudes in February and March. Decrease of 5 magnitudes took seven months.

*S Virginis.*—Maximum May 15, 7·5 magnitude.

## SHORT PERIOD VARIABLES.

(Observed with binocular or naked eye.)

*W Cygni.*—Maxima 1893, February 10, July 7, December 1; 31 observations. Minima May 15, September 20; December 31, irregular and fluctuating.

*R Scuti.*—Maxima June 12, 4·8 magnitude; September 10, 5·25 magnitude. Minima April 15, 6 magnitude; August 20, 6·75 magnitude; October 16, 7·1 magnitude; 21 observations.

*α Herculis.*—Small maximum, March 15; maximum May 15; small maximum August 1; maximum November 1. Minima February 10, April 15, July 1 ?, September 3; 22 observations.

*u Herculis.*—Maxima March 7, May 1, June ?, August 29, and November 10. Minima February ?, April 3, May 17, August 1, September 20, December ?; 22 observations.

*T Monocerotis.*—Maxima February 5, March 7, or before, March 28, April 26, September 11, or later, October 7, November 1, November 26, December 24. Minima January 19, February 21, March 19, April 15, October 18, December 14; 68 observations. Owing to fine weather in the spring, 23 observations were made in the period March 19 to April 14. The increase occupied about 9 days, and the decrease about 19 days.

X *Cygni.*—Seen at or near maximum on January 3, January 20, March 10, March 26, April 12, May 17, June 16, July 3, August 4, August 21, September 7, September 23, October 9, October 25, November 12, and December 14. Minima on January 29, May 8, June 10, July 12, July 29, August 13, September 1, October 4, October 19, November 3, November 20, December 8, and December 24. 164 observations. A generalised curve shows that the rise from minimum is quick, taking six days. There is then an equally rapid fall for two days. For the next three days the fall ceases and there is a halt, and perhaps a slight recovery of light. The remaining five days are taken in reaching the minimum, but this varies in magnitude, the star being considerably fainter at some minima than at others.



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*δ Cephei.*—Observed on 193 nights. Rise more rapid than the decrease, which slows off gradually to a minimum. Somewhat unaccountable irregularities were noticed on March 19, August 16, August 25, September 21, and October 23, when a temporary halt or recovery of light seemed to have taken place.

*ζ Geminorum.*—Observed when possible. In April it did not appear to fall below *γ* Geminorum in brightness, but this may have been the effect of twilight.

*S Sagittæ.*—Observed when possible. Rapid recovery, and very quick passage through the minimum.

*η Aquilæ* and *β Lyræ.*—Observed when possible. Fluctuations of the light of *β* Lyræ suspected during time of the secondary minimum.

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## II.

## Observations of Variable Stars in 1892.

By Lieut.-Col. E. E. MARKWICK, F.R.A.S.

The following observations were made in the same way as those given at pp. 65—72, Vol. I., Part IV., of "Memoirs," of the Association, viz., with a binocular magnifying about five diameters, and occasionally a $2\frac{3}{4}$-in. refractor, power 37. Owing to severe illness in April, the writer was precluded for several months from observing; in fact only a few scattered notes were made after that date. Hence the record is very meagre. Still, it is thought that some of the observations may be of use to those who are working out the period or details of variation of any of the stars mentioned. Scale of brightness and comparison stars generally same as before.

*R Andromedæ.*—There was a little doubt about identification, but I am confident that from 1891, December 7, to 1892, February 1, it was not above $8^m \cdot 5$. Observed on eight days.

*α Cassiopeiæ.*—On six dates between January 1 and February 1, about $2^m \cdot 4$.

*R Arietis.*—On January 1, invisible in the telescope; probably below 12 m. On four nights in that month and February, it was invisible in binocular, but on February 26 was 9·5 in telescope. On March 8, estimated 8 m, but there was moonlight. March 15, suspected in binocular.

*ο (Mira) Ceti.*—January 1, 9·8; January 25, 9·5. The minimum was predicted in the "Companion to the Observatory," for 1891, December 29. Hence as I made it between 9·5 and 10 on 1891, December 20, it is pretty clear that the star at this particular minimum, did not fall below 10 m.



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*U Ceti.*

| | | |
|---|---|---|
| Jan. 1 | 7·65 | Seen in the binocular. No particular colour in the telescope. |
| 3 | 7·8 | Not very different in brightness from a star which precedes it about 1¼° on same parallel. |
| 5 | 7·5 | Seen in moonlight. |
| 24 | 6·8 | One step less than 262 (U.A.) Ceti. |
| 27 | 6·8 | Do. |
| Feb. 1 | 6·6 | Perhaps one step brighter than 262. |

*β Persei (Algol).*—G.M.T. is given, with probable error of ± 3 m.

| | h | m | |
|---|---|---|---|
| Jan. 1 | 7 | 53 | 2·14 |
| 3 | 10 | 35 | 2·2 |
| 4 | 6 | 22 | 2·14 |
| | 6 | 35 | 2·14 |
| | 7 | 2 | 2·14 |
| 27 | 7 | 53 | 2·59 |
| Jan. 27 | 8 | 18 | 2·74 |
| | 8 | 53 | 2·7 |
| | 9 | 16 | 2·84 |
| | 9 | 55 | 3·03 |
| | 11 | 0 | 3·0 |
| | 11 | 55 | 3·2 |

λ *Tauri.*

| | h | m | |
|---|---|---|---|
| Jan. 1 | 7 | 55 | 4·0 |
| 3 | 10 | 41 | 3·6 |
| 24 | 7 | 20 | 3·8 |
| | 8 | 15 | 3·95 |
| | 8 | 32 | 4·0 |
| Jan. 24 | 9 | 33 | 3·8 |
| 27 | 7 | 57 | 3·7 |
| Feb. 24 | 8 | 25 | 3·8 |
| 25 | 8 | 5 | 4·0 |

ε *Aurigæ.*—Apparently about 3·1 m. on the following dates: January 1, 3, 5, 24, 27, 29, February 24, and March 8.

*R Leporis.*—On January 3, estimated 8–8·5 in binocular. On four nights subsequently not seen.

*S* (64) *Eridani.*—January 3, 5·2; 24, 5·0; February 24, 4·7.

*B* 96 *Orionis.*—January 3, 6·5; 24, 6·5; 29, 6·7; February 24, 6·6.

*B II.* 16 *Leporis.*—January 3, 6·8; January 24, and February 24, 6·2. It is difficult to judge the brightness of this object, owing to the close proximity of several stars a little greater in brightness.

*R Aurigæ.*—January 1, about 9·2, and ruddy as seen in the telescope. On January 3 and 29 it was taken as *min. vis.* in binocular, or 9 m. On February 24, doubtful if seen. March 22 and 28, about 11 m. in telescope. Far below a star which precedes it, and is a trifle S.

31 *Orionis.*

| | | | |
|---|---|---|---|
| Jan. 3 | 5·1 | Feb. 24 | 5·6 |
| 29 | 5·1 | Mar. 8 | 5·1, lovely clear red in 2¾-in. |

δ *Orionis.*—January 3, 2·3; January 24, 29, and February 24, 2·5.

α *Orionis.*—January 1 and 3, "brighter than Aldebaran"; on January 24, 29, and February 24, "slightly > Aldebaran." I can infer no variation. [The variation was not obvious in 1893. —J.E.G.]

*U Orionis.*—*See* "Monthly Notices," Royal Astronomical Society, Vol. LII., p. 604.



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*η Geminorum.*

| | | | | | |
|---|---|---|---|---|---|
| Jan. 1 | 4 | Jan. 29 | 3·6 | Mar. 28 | 3·7 |
| 3 | 4 | Feb. 24 | 3·7 | 30 | 3·7 |

*V Monocerotis*—January 3 and 24, invisible in binocular.

| | | |
|---|---|---|
| Feb. 24 | 8 | Held steadily in binocular. |
| Mar. 8 | 7·2 | Just glimpsed in moonlight. |
| 15 | 8 | |
| 22 | 7·6 | Estimated. |

*T Monocerotis.*

| | h | m | | | h | m | |
|---|---|---|---|---|---|---|---|
| Jan. 3 | 11 | 24 | 6·6 | Feb. 24 | 10 | 40 | 6·9 |
| 24 | 8 | 37 | 6·1 | Mar. 28 | 10 | 12 | 6·9 |

*S Monocerotis.*—On the four dates given for the preceding star it was about 5·1.

*ζ Geminorum.*

| | | | |
|---|---|---|---|
| Jan. 3 | 4·2 | Mar. 28 | 3·95 |
| Feb. 24 | 4·0 | 30 | 4·15 |

*R Geminorum.*—Invisible in binocular on January 1, February 24, and March 28.

*R Canis Majoris.*—Again I have not succeeded in catching this star at minimum, although it was frequently observed for that purpose. Still, as there is a question as to secondary minimum in the period of an Algol-type star, the observations are given for what they are worth. Compared with 144 (U.A.) of Canis Major.

| | h | m | | | h | m | | | h | m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan. 3 | 11 | 39 | 6·0 | Feb. 26 | ? | | 5·9 | Mar 22 | 8 | 25 | 6·0 |
| 6 | 10 | 35 | 6·0 | | 10 | 13 | 6·05 | | 10 | 12 | 6·0 |
| 27 | 8 | 19 | 6·1 | Mar. 8 | 7 | 42 | 5·9 | 28 | 9 | 50 | 6·05 |
| 29 | 10 | 6 | 6·1 | | 9 | 41 | 6·1 | 29 | 10 | 2 | 6·0 |
| Feb. 5 | 9 | 40 | 6·0 | 15 | 8 | 12 | 6·0 | 30 | 9 | 45 | 6·0 |
| 6 | 10 | 25 | 6·3 | 18 | 8 | 57 | 6·0 | 31 | 9 | 35 | 6·15 |
| 24 | 8 | 17 | 6·0 | 21 | 8 | 25 | 6·0 | | | | |
| | 10 | 12 | 5·9 | | | | | | | | |

*U Monocerotis.*

| | | | | | |
|---|---|---|---|---|---|
| Jan. 3 | 7·25 | Mar. 8 | Invisible in binocular. | Mar. 28 | 6·9 |
| Feb. 24 | 7·0 | 15 | 8·5 | 29 | 7·25 |
| 26 | 6·9 | 22 | 8 | 30 | 7·1 |

*R Leonis.*—January 3, 8·5, just glimpsed in the binocular. February 23 and 24, lost in that instrument. March 8, about 10m, being equal to the n. of the two stars which form an isosceles triangle with it. March 22, 10·25.

*R Ursæ Majoris.*—On January 3 invisible in binocular. Then:—

| | | | | | |
|---|---|---|---|---|---|
| Jan. 24 | 8·5 | Feb. 24 | 6·6 | | |
| 27 | 8—8·5 | 26 | 7 | | |
| 29 | 8 | Mar. 8 | 7·5 | Slightly ruddy in telescope. | |
| Feb. 1 | 7·5 | 29 | 8·5 | | |
| 23 | 6·8 | | | | |

*R Coronæ Borealis.*—On March 28 and 31 it was about 6·8 or 7. So, between November 1891 and March 1892, this star must have recovered the light which it lost after May of the former year.



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*X Herculis.*—Compared with two stars between which it is situated. That preceding, *a*, is taken at 7 m.; the one following a little north, *b*, at 6 m. The result is shown in the first column of magnitudes. If a is used alone as comparison star, the result is given in the second column.

| | | | | |
|---|---|---|---|---|
| Sept. 14 | 6>a, | 3>b | 6·05 | 6·4 |
| 16 | 8>a, | 5>b | 5·85 | 6·2 |
| 28 | 7>a, | 5>b | 5·9 | 6·3 |

*R Draconis.*

| | | | | |
|---|---|---|---|---|
| Jan. 24 | 7·4 | Feb. 1 | 8 | |
| 27 | 7·5 | 24 | 8·5—9 | Very difficult in binocular. |
| 29 | 7·35 | 25 | 9 | |

*R Lyræ.*—On January 5, about 4·5, and on January 27, say 4·3; then, on

| | | | | | |
|---|---|---|---|---|---|
| Sept 13 | 4·6 | Sept. 16 | 4·4 | Sept. 25 | 4·5 |
| 14 | 4·5 | 21 | 4·6 | 28 | 4·5 |

*R Aquilæ.*—Observations commenced a little too late to allocate the maximum with certainty. It might have occurred about September 21; but on the other hand it very possibly occurred before this series of observations began.

| | | | | | |
|---|---|---|---|---|---|
| Sept. 14 | 6·9 | Sept. 24 | 7·0 | Sept. 28 | 7·8 |
| 16 | 6·9 | 25 | 7·4 | Oct. 3 | 7·5—8 |
| 21 | 6·75 | | | | |

*R Cygni.*—January 1 estimated 9·5—10. January 5, invisible in binocular. January 27, about 8m. February 1, plainly seen in twilight with binocular, say about 7m.

*R Pegasi.*—Not seen in binocular on January 3, 5, 24, 25, 27, and February 1.

19 *Piscium.*—5·7 on January 27.

*R Cassiopeiæ.*

| | | |
|---|---|---|
| Jan. 5 | | Not seen in binocular. |
| 27 | <9 | A faint point glimpsed. |
| Feb. 2 | 7 | |
| 24 | 5·9 | Very bright. Above any other star in the immediate vicinity. |
| 25 | 5·5 | |
| 26 | 6 (?) | Magnitude not determined. Probably less than before. |
| Mar. 8 | 5·5 | |
| 29 | 6·7 | |

## MISCELLANEOUS OBSERVATIONS.

In addition to the above, observations were made on the brightness of a certain number of stars with 3rd type spectrum, a list of which had been furnished by the Director of the Section, and a few others.

47 *Piscium.*—Two observations, about 5·3 m.

*Lal.* 2598 *Ceti.*—Five observations. From 6·4 to 6·6.

165 (*U. Arg.*) *Ceti.*—Five observations, 5·5 to 5·7.



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*Lal.* 3717 *Ceti.*—Three observations. 5·9 to 6·0.

*D. M.* + 8° 443.—Five observations. 6·8 to 7·2.

$\rho$ *Arietis.*—Fifteen observations. Compared with H. P. 458, 5·78 m. Apparent variation from 5·4 to 5·9. It was thought sometimes less and at other times greater than the comparison star.

*D. M.* + 62° 597.—Five observations. 4·6 (?) to 6. I could not infer variability with any confidence notwithstanding the apparent discrepancies. The star is near several others of about same brightness rendering comparison difficult. Moreover, it sometimes approaches the zenith, and every one who has tried to observe a star with a binocular when it was in that position, must know how unreliable the observation is. However, two observations in 1890 gave 5·4, and three in 1891, 5·4 once, 6·4 twice.

$o^1$ *Orionis.*—5·0 to 5·4. Five observations.

1 *Lyncis.*—About 5·2. By nine observations in 1889, 1891, and 1892, I generally make it so.

*D. M.* + 17° 1479. 7 m. Three observations.

51 *Geminorum.*—Possibly there may be small variation.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1889 | Mar. | 8 | 5·1 | 1892 | Jan. | 3 | 5·1 |
| 1890 | Mar. | 19 | 5·47 | | Feb. | 24 | 5·1 |
| | Apr. | 9 | 5·6 | | Mar. | 28 | 5·2 |
| 1891 | Mar. | 2 | 5·6 | | | 30 | 5·4 |
| | | 11 | 5·6 | | | | |

*Birm.* 168.—Ten observations. 5·13 to 5·4. From 19 observations in 1889–1891, I suspected variation of about $\frac{1}{2}$ a mag.; but the later determinations do not seem to bear this out.

56 *Leonis.*—1892, March 29, about 6·1. Previous observations in 1890–91, range from 6·45 to 6·8.

40 *Comæ Berenices.*—March 29, 6·4. In previous years 5·9 to 6·48.

*Birm.* 389. Six observations. 5·6 to 5·9.

*D.M.* + 17° 3241. 15 observations in 1891, range from 6·2 to 6·5.

18 *Cephei.*—Two observations in 1891, and three in 1892, range from 5·4 to 5·6. I fear it cannot be said that any very definite case of variability has been established by these observations.

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## III.

## Observations of Variable Stars from May 1892 to January 1894.

By JOAO DE MORAES PEREIRA, St. Michael's, Azores.

Lat. + 37° 44′ 15″
Long. 1h 42m 45s W. Gr.

HOUR and all particulars of the observation recorded. Harvard magnitudes. Argelander's method; comparison in grades; one grade = 0·14 mag. The mean magnitude adopted is the arithmetical mean of all the estimates, two or more, computed in almost every case with two decimals. Instruments employed, 4¼-in. refractor, powers 40, 100, and 160; binocular, 2-in. object glasses. Whenever possible, naked eye comparisons were preferred.

### T CASSIOPEIÆ.

| | |
|---|---|
| 1892—July 27 | 11·2 |
| Sept. 20 | 9·7 |
| „ 21 | 9·6 |
| „ 23 | 9·5 |
| Oct. 2 | 8·9 |
| „ 21 | 8·9 |
| Nov. 18 | 8·9 |
| „ 25 | 8·9 |
| 1893—Feb. 12 | 7·8 |
| „ 17 | 8·0 |
| „ 18 | 7·7 |
| Mar. 3 | 7·7 |
| „ 11 | 8·1 |
| „ 29 | 8·2 |
| May 13 | 8·8 |
| „ 17 | 9·0 |
| „ 21 | 8·8 |
| „ 28 | 10·7 |
| June 2 | 9·0 |
| „ 9 | 9·8 |
| „ 12 | 9·8 |
| „ 17 | 10·0 |
| „ 20 | 10·5 |
| „ 27 | 10·3 |
| „ 30 | 11·4 |
| July 4 | 11·4 |
| „ 6 | 11·3 |
| „ 14 | 11·6 |
| „ 21 | 11·6 |
| „ 23 | 11·6 |
| „ 29 | 12·0 |
| Aug. 5 | 12·7 |
| „ 7 | 12·7 |
| „ 17 | 12·7 |
| Sept. 1 | 12·7 |
| „ 8 | 12·7 |
| „ 29 | 12·4 |
| Oct. 3 | 12·0 |
| „ 29 | 10·5 |
| 1893—Nov. 2 | 10·0 |
| „ 10 | 9·5 |
| „ 18 | 9·6 |
| Dec. 13 | 9·2 |
| „ 18 | 8·7 |
| „ 27 | 8·9 |
| 1894—Jan. 2 | 8·7 |

### S PISCIUM.

| | |
|---|---|
| 1893—Sept. 3 | 9·5 |
| „ 5 | 9·8 |
| „ 14 | 9·9 |
| „ 20 | 10·0 |
| „ 30 | 10·2 |
| Oct. 19 | 10·6 |
| Nov. 3 | 10·7 |
| „ 6 | 10·9 |
| „ 26 | Invis. |
| Dec. 10 | 12·1 |
| „ 27 | 12·5 |

### S CASSIOPEIÆ.

| | |
|---|---|
| 1892—June 8 | Invis. |
| July 23 | „ |
| 1893—Feb. 12 | 7·4 |
| May 28 | 8·7 |
| June 9 | 9·6 |
| „ 17 | Invis. |
| Aug. 7 | „ |
| „ 17 | 9·5 |

### — PISCIUM.

| | |
|---|---|
| | h m |
| A.R. 1893 | 1 15·9 |
| D. „ | +9 7·0 |
| 1893—Sept. 3 | Invis. |
| „ 5 | „ |
| „ 14 | „ |
| „ 20 | „ |
| „ 30 | „ |
| Oct. 19 | „ |
| Nov. 3 | „ |
| „ 26 | „ |
| Dec. 10 | „ |
| „ 17 | „ |

### R SCULPTORIS.

| | |
|---|---|
| 1893—Sept. 20 | 6·9 |

### T PERSEI.

| | |
|---|---|
| 1892—Aug. 17 | 8·8 |
| Oct. 21 | 9·0 |
| Nov. 18 | 9·0 |
| „ 20 | 9·1 |
| „ 21 | 9·3 |
| Dec. 12 | 9·3 |
| 1893—Feb. 12 | 9·0 |
| July 21 | 9·1 |
| Aug. 7 | 9·1 |
| „ 17 | 9·5 |
| Sept. 4 | 8·9 |
| „ 8 | 9·1 |
| „ 14 | 9·1 |
| „ 19 | 9·1 |
| „ 29 | 9·1 |
| Oct. 8 | 8·8 |
| Nov. 3 | 9·0 |
| „ 18 | 9·8 |



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### o CETI (MIRA).

| | |
|---|---|
| 1893—June 17 | 4·2 |
| „ 20 | 4·5 |
| July 16 | 5·6 |
| „ 22 | 5·9 |
| „ 23 | 5·9 |
| „ 25 | 6·1 |
| „ 31 | 6·1 |
| Aug. 7 | 6·9 |
| „ 8 | 6·5 |
| „ 16 | 6·9 |
| „ 19 | 7·1 |
| „ 23 | 7·1 |
| Sept. 1 | 7·2 |
| „ 3 | 7·7 |
| „ 5 | 7·7 |
| „ 8 | 7·8 |
| „ 12 | 8·1 |
| „ 13 | 7·9 |
| „ 14 | 8·0 |
| „ 15 | 8·0 |
| „ 17 | 8·1 |
| „ 17 | 8·3 |
| „ 19 | 8·3 |
| „ 20 | 8·3 |
| „ 27 | 8·1 |
| Oct. 2 | 8·4 |
| „ 3 | 8·5 |
| „ 6 | 8·4 |
| „ 7 | 8·5 |
| „ 9 | 8·7 |
| „ 13 | 8·6 |
| „ 19 | 8·8 |
| „ 22 | 8·8 |
| „ 28 | 9·0 |
| „ 29 | 8·8 |
| Nov. 2 | 8·9 |
| „ 3 | 8·8 |
| „ 6 | 9·0 |
| „ 10 | 8·8 |
| „ 13 | 8·8 |
| „ 24 | 8·8 |
| Dec. 4 | 8·9 |
| „ 5 | 8·8 |
| „ 7 | 8·8 |
| „ 10 | 8·9 |
| „ 13 | 8·9 |
| „ 17 | 9·0 |
| „ 18 | 8·6 |
| „ 19 | 8·6 |
| „ 21 | 8·6 |
| „ 26 | 8·5 |
| „ 27 | 8·5 |
| „ 28 | 8·5 |
| 1894—Jan. 2 | 8·6 |
| „ 3 | 8·6 |
| „ 4 | 8·6 |
| „ 13 | 8·6 |

### S PERSEI.

| | |
|---|---|
| 1892—Aug. 17 | 8·8 |
| Oct. 21 | 9·8 |
| Nov. 18 | 9·8 |
| „ 20 | 10·4 |
| „ 21 | 10·4 |
| Dec. 12 | 10·7 |
| 1893—Feb. 12 | 10·8 |
| July 21 | 10·0 |
| Aug. 7 | 10·0 |
| Sept. 4 | 10·0 |
| „ 8 | 10·0 |
| „ 14 | 9·8 |
| „ 19 | 10·0 |
| „ 29 | 9·8 |
| Oct. 8 | 9·9 |
| „ 29 | 9·5 |
| Nov. 3 | 9·5 |
| „ 18 | 9·8 |

### TAURI M.P. 477.

| | h | m |
|---|---|---|
| A.R. 1893 | 3 | 47·28 |
| B. „ | +7° | 27·4 |

| | |
|---|---|
| 1893—Dec. 10 | 7·2 |
| „ 13 | 7·5 |
| „ 18 | 7·5 |
| 1894—Jan. 2 | 7·3 |
| „ 3 | 7·5 |
| „ 13 | 7·4 |

### λ TAURI.

| | |
|---|---|
| 1893—Sept. 3 | 3·8 |
| „ 20 | 3·9 |
| Oct. 9 | 3·8 |
| „ 13 | 3·8 |
| „ 19 | 3·9 |
| Nov. 6 | 3·9 |
| Dec. 10 | 3·8 |
| „ 13 | 3·8 |
| „ 18 | 3·8 |
| „ 27 | 3·7 |
| „ 28 | 3·9 |
| 1894—Jan. 2 | 3·6 |
| „ 3 | 3·6 |
| „ 4 | 3·9 |
| „ 13 | 3·8 |

### R ERIDANI.

| | |
|---|---|
| 1893—Sept. 17 | 5·8 |
| Oct. 19 | 5·9 |
| „ 23 | 5·7 |
| Dec. 5 | 5·8 |
| „ 10 | 5·8 |
| „ 18 | 5·7 |
| „ 19 | 5·8 |
| „ 28 | 5·7 |

### R LEPORIS.

| | |
|---|---|
| 1893—Jan. 7 | 7·3 |
| „ 12 | 7·3 |
| „ 29 | 7·7 |
| „ 31 | 7·7 |
| Feb. 6 | 7·7 |
| „ 7 | 7·7 |
| „ 11 | 7·7 |
| „ 14 | 7·5 |
| „ 17 | 7·7 |
| „ 18 | 7·7 |
| „ 19 | 7·7 |
| Sept. 17 | 7·4 |
| Oct. 19 | 7·4 |
| „ 23 | 7·3 |
| Nov. 7 | 7·8 |
| Dec. 5 | 7·6 |
| „ 10 | 7·5 |
| „ 18 | 7·0 |
| „ 19 | 6·8 |
| „ 27 | 6·9 |
| „ 28 | 7·1 |
| 1894—Jan. 2 | 7·1 |
| „ 3 | 7·1 |
| „ 4 | 7·1 |
| „ 13 | 6·8 |

### R AURIGÆ.

| | |
|---|---|
| 1892—Nov. 14 | 9·7 |
| „ 18 | 9·4 |
| „ 20 | 9·6 |
| „ 21 | 9·4 |
| 1893—Jan. 12 | 7·9 |
| Sept. 5 | 12·0 |
| „ 8 | Invis. |
| Oct. 2 | „ |
| Nov. 7 | 12·0 |
| „ 10 | 11·8 |

### α ORIONIS.

| | |
|---|---|
| 1893—Dec. 10 | 0·6 |
| „ 18 | 0·6 |
| „ 27 | 0·8 |
| „ 29 | 0·8 |
| 1894—Jan. 2 | 0·6 |
| „ 3 | 0·8 |
| „ 13 | 0·8 |

### R LYNCIS.

| | |
|---|---|
| 1892—Nov. 14 | Invis. |
| 1893—Jan. 12 | „ |

### R PUPPIS.

| | |
|---|---|
| 1893—Nov. 7 | 7·2 |



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## — LEONIS.

A.R. 1893 h 9 m 40·5
D. „ +7° 11·8

| | | |
|---|---|---|
| 1893—Dec. | 18 | 6·3 |
| „ | 27 | 5·6 |
| 1894—Jan. | 3 | 6·0 |

## R LEONIS.

| | | |
|---|---|---|
| 1893—Mar. | 12 | 9·2 |
| „ | 20 | 9·1 |
| Apr. | 3 | 8·8 |
| „ | 26 | 7·4 |
| May | 5 | 7·8 |
| „ | 9 | 7·2 |
| „ | 12 | 7·2 |
| „ | 13 | 7·2 |
| „ | 14 | 7·2 |
| „ | 17 | 7·1 |
| „ | 18 | 7·1 |
| „ | 19 | 7·0 |
| „ | 27 | 7·0 |
| „ | 28 | 6·8 |
| „ | 31 | 6·7 |
| June | 1 | 6·5 |
| „ | 2 | 6·7 |
| „ | 6 | 6·6 |
| „ | 9 | 6·3 |
| „ | 9 | 6·4 |
| „ | 10 | 6·4 |
| „ | 13 | 6·4 |
| „ | 14 | 6·4 |
| „ | 15 | 6·1 |
| „ | 17 | 5·9 |
| „ | 20 | 6·1 |
| „ | 27 | 5·6 |
| July | 2 | 5·5 |
| „ | 4 | 5·5 |
| Oct. | 20 | 9·0 |
| „ | 23 | 8·9 |
| Nov. | 7 | 9·9 |
| Dec. | 10 | 10·5 |
| „ | 18 | 10·3 |
| „ | 27 | 10·0 |
| 1894—Jan. | 3 | 10·0 |

## U HYDRÆ.

| | | |
|---|---|---|
| 1893—Apr. | 5 | 5·6 |
| „ | 6 | 5·6 |
| „ | 9 | 5·4 |
| „ | 9 | 5·2 |
| „ | 16 | 5·2 |
| „ | 18 | 5·5 |
| „ | 20 | 5·7 |
| „ | 24 | 5·2 |
| May | 1 | 5·4 |
| „ | 4 | 5·2 |
| „ | 4 | 5·4 |
| 1893—May | 5 | 5·4 |
| „ | 7 | 5·5 |
| „ | 9 | 5·4 |
| „ | 10 | 5·4 |
| „ | 13 | 5·4 |
| „ | 14 | 5·5 |
| „ | 17 | 5·5 |
| „ | 18 | 5·5 |
| „ | 19 | 5·6 |
| „ | 26 | 5·2 |
| „ | 27 | 5·2 |
| „ | 28 | 4·8 |
| „ | 28 | 4·7 |
| „ | 31 | 5·4 |
| June | 1 | 5·2 |
| „ | 2 | 5·4 |
| „ | 4 | 5·5 |
| „ | 6 | 5·7 |
| „ | 9 | 5·5 |
| „ | 10 | 5·5 |
| „ | 13 | 5·2 |
| „ | 14 | 5·4 |
| „ | 15 | 4·8 |
| „ | 17 | 5·2 |
| Dec. | 29 | 5·5 |

## R URSÆ MAJ.

| | | |
|---|---|---|
| 1892—July | 19 | 11·0 |
| 1893—Jan. | 10 | 7·8 |
| „ | 12 | 7·8 |
| Feb. | 8 | 9·2 |
| „ | 11 | 9·3 |
| „ | 17 | 9·5 |
| May | 13 | 10·6 |
| „ | 17 | 10·4 |
| „ | 19 | 10·7 |
| „ | 29 | Invis. |
| June | 9 | „ |
| „ | 25 | 12·5 |
| „ | 27 | Invis. |
| July | 4 | 12·5 |
| „ | 16 | Invis. |
| „ | 29 | „ |
| Aug. | 5 | 11·5 |
| „ | 7 | 11·5 |
| „ | 15 | 10·3 |
| „ | 18 | 10·3 |
| „ | 24 | 9·8 |
| Sept. | 3 | 9·1 |
| „ | 5 | 8·4 |
| „ | 8 | 8·5 |
| „ | 14 | 8·0 |
| „ | 29 | 7·7 |
| Oct. | 3 | 7·7 |
| „ | 23 | 7·1 |
| Nov. | 2 | 7·7 |
| „ | 7 | 8·0 |
| „ | 10 | 8·3 |
| Dec. | 13 | 9·3 |
| „ | 18 | 9·3 |
| „ | 27 | 9·8 |
| 1894—Jan. | 2 | 9·9 |

## T URSÆ MAJ.

| | | |
|---|---|---|
| 1892—July | 19 | 7·4 |
| 1893—Jan. | 10 | 12·5 |
| „ | 12 | 12·5 |
| Feb. | 6 | 10·0 |
| „ | 8 | 9·6 |
| „ | 11 | 9·3 |
| „ | 14 | 9·3 |
| „ | 17 | 9·1 |
| „ | 19 | 9·1 |
| Mar. | 3 | 8·5 |
| „ | 10 | 8·2 |
| „ | 19 | 8·1 |
| Apr. | 1 | 7·4 |
| May | 13 | 9·0 |
| „ | 17 | 9·2 |
| „ | 21 | 9·4 |
| „ | 28 | 9·5 |
| June | 2 | 9·6 |
| „ | 9 | 10·5 |
| „ | 13 | 10·2 |
| „ | 27 | 10·0 |
| July | 4 | 12·2 |
| „ | 16 | 11·8 |
| „ | 29 | Invis. |
| Aug. | 4 | „ |
| „ | 5 | „ |
| „ | 7 | „ |
| „ | 15 | „ |
| „ | 18 | „ |
| „ | 24 | „ |
| Sept. | 3 | „ |
| „ | 5 | „ |
| „ | 8 | 13·2 |
| „ | 14 | Invis. |
| „ | 29 | „ |
| Oct. | 3 | 12·0 |
| „ | 23 | 9·7 |
| Nov. | 7 | 9·0 |
| „ | 10 | 8·9 |
| Dec. | 13 | 8·4 |
| „ | 18 | 7·9 |
| „ | 27 | 8·1 |

## S URSÆ MAJ.

| | | |
|---|---|---|
| 1892—July | 7 | 10·5 |
| „ | 19 | 10·4 |
| 1893—Jan. | 12 | 11·3 |
| „ | 12 | 10·1 |
| Feb. | 8 | 12·0 |
| „ | 11 | 11·4 |
| „ | 11 | 11·6 |
| „ | 14 | 11·4 |
| „ | 17 | 11·0 |
| „ | 19 | 10·8 |
| Mar. | 3 | 9·7 |
| „ | 10 | 9·5 |
| „ | 19 | 9·3 |
| Apr. | 1 | 8·8 |
| May | 13 | 7·6 |



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| | |
|---|---|
| 1893—May 17 | 7·5 |
| „ 21 | 7·8 |
| „ 28 | 7·6 |
| June 2 | 7·9 |
| „ 9 | 8·2 |
| „ 13 | 8·2 |
| „ 27 | 8·6 |
| July 4 | 9·6 |
| „ 16 | 10·2 |
| „ 29 | 11·2 |
| Aug. 5 | 11·4 |
| „ 7 | 10·8 |
| „ 15 | 12·0 |
| „ 18 | 11·7 |
| „ 24 | Invis. |
| Sept. 3 | „ |
| „ 5 | 12·5 |
| „ 8 | 12·3 |
| „ 14 | 11·7 |
| „ 29 | 10·7 |
| Oct. 3 | 10·6 |
| „ 23 | 9·2 |
| Nov. 7 | 8·6 |
| „ 12 | 8·8 |
| Dec. 18 | 7·7 |
| „ 27 | 7·7 |

## R Hydræ.

| | |
|---|---|
| 1893—Apr. 9 } June 14 } | 8·0 |
| „ 14 | 9·5 |
| „ 16 | 9·3 |
| „ 17 | 9·4 |
| „ 27 | 9·0 |
| „ 30 | 8·9 |
| July 2 | 8·9 |
| „ 2 | 9·0 |
| „ 5 | 8·7 |
| „ 6 | 8·6 |
| „ 11 | 8·6 |
| „ 14 | 8·4 |
| „ 18 | 8·3 |
| „ 19 | 8·2 |
| „ 29 | 7·8 |
| Aug. 5 | 7·5 |
| „ 7 | 7·3 |
| „ 8 | 7·3 |
| Dec. 29 | 4·6 |

## S Bootis.

| | |
|---|---|
| 1893—July 29 | 9·0 |
| Aug. 7 | 8·6 |
| „ 18 | 8·4 |
| Sept. 3 | 8·4 |
| „ 5 | 8·4 |
| „ 8 | 8·4 |
| „ 14 | 8·7 |
| „ 29 | 9·5 |
| Oct. 3 | 9·8 |
| Nov. 7 | 10·4 |
| „ 10 | 11·5 |

## — Bootis.

h m
A.R. 1900 14 22·3
D. „ + 5° 7

| | |
|---|---|
| 1893—Sept. 4 | Not Identified. |
| „ 14 | ±11·0 |

## R Camelop.

| | |
|---|---|
| 1892—May 30 | 9·3 |
| June 2 | 9·3 |
| „ 7 | 9·2 |
| July 7 | 8·7 |
| „ 12 | 8·6 |
| „ 19 | 8·7 |
| „ 26 | 8·7 |
| Oct. 18 | 10·3 |
| Nov. 25 | 12·1 |
| 1893—Jan. 10 | Invis. |
| Mar. 11 | 9·2 |
| May 17 | 9·0 |
| „ 19 | 9·2 |
| „ 21 | 8·9 |
| „ 28 | 9·0 |
| June 2 | 9·2 |
| „ 9 | 9·1 |
| „ 13 | 9·4 |
| „ 15 | 9·5 |
| „ 27 | 10·0 |
| July 4 | 10·3 |
| „ 16 | 10·7 |
| „ 19 | 11·6 |
| Aug. 4 | 11·6 |
| „ 5 | 12·3 |
| „ 7 | 12·5 |
| „ 15 | 12·6 |
| „ 18 | 12·7 |
| „ 24 | Invis. |
| Sept. 2 | 13·0 |
| „ 5 | 13·0 |
| „ 8 | 13·0 |
| „ 14 | Invis. |
| „ 29 | „ |
| Oct. 3 | 13·10 |
| „ 13 | Invis. |
| „ 29 | 12·3 |
| Nov. 6 | 11·5 |
| „ 7 | 11·0 |
| „ 10 | 10·7 |
| „ 24 | 10·0 |
| Dec. 7 | 9·1 |
| „ 13 | 9·9 |
| „ 18 | 8·8 |
| „ 21 | 8·8 |
| „ 27 | 8·6 |
| „ 27 | 8·9 |
| „ 29 | 8·6 |
| „ 29 | 8·7 |
| 1894—Jan. 2 | 8·8 |

## V Bootis.

| | |
|---|---|
| 1893—Sept. 14 | 8·0 |

## Z Scorpii.

| | |
|---|---|
| 1893—May 14 | 9·0 |
| Oct. 8 | 9·2 |
| „ 13 | 9·3 |
| Dec. 29 | 9·9 |

## R Ursæ Min.

| | |
|---|---|
| 1892—May 30 | 9·1 |
| June 7 | 9·2 |
| July 26 | 9·9 |
| Aug. 22 | 9·7 |
| Nov. 25 | 9·5 |
| 1893—Jan 12 | 10·0 |
| Mar. 10 | 10·0 |
| „ 19 | 9·6 |
| Apr. 24 | 10·3 |
| May 12 | 9·5 |
| „ 13 | 9·3 |
| „ 14 | 10·3 |
| „ 17 | 10·6 |
| „ 18 | 10·7 |
| „ 19 | 10·7 |
| „ 21 | 10·5 |
| „ 28 | 10·0 |
| June 2 | 10·3 |
| „ 9 | 10·0 |
| „ 13 | 10·0 |
| „ 27 | 9·6 |
| July 4 | 10·2 |
| „ 16 | 10·4 |
| „ 29 | 10·6 |
| Aug. 5 | 10·6 |
| „ 7 | 10·0 |
| „ 18 | 10·7 |
| „ 24 | 10·3 |
| Sept. 2 | 10·2 |
| „ 5 | 10·4 |
| „ 8 | 10·0 |
| „ 14 | 10·2 |
| „ 29 | 10·2 |
| Oct. 3 | 10·0 |
| „ 29 | 9·6 |
| Nov. 6 | 10·0 |
| „ 10 | 10·2 |
| Dec. 13 | 9·6 |
| „ 18 | 9·5 |
| „ 21 | 9·3 |
| „ 27 | 9·5 |
| 1894—Jan. 2 | 9·6 |

## R Draconis.

| | |
|---|---|
| 1892—Aug. 22 | 9·7 |
| Nov. 25 | 9·9 |
| 1893—Jan. 12 | 13·0 |
| Mar. 3 | Invis. |



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| | |
|---|---|
| 1893—Mar. 10 | 11·5 |
| „ 11 | 11·5 |
| Apr. 24 | 8·4 |
| May 12 | 7·6 |
| „ 13 | 7·6 |
| „ 14 | 7·6 |
| „ 17 | 7·5 |
| „ 18 | 7·5 |
| „ 19 | 7·5 |
| „ 21 | 7·5 |
| „ 28 | 7·5 |
| June 1 | 7·5 |
| „ 2 | 7·5 |
| „ 9 | 7·5 |
| „ 13 | 7·7 |
| „ 15 | 7·9 |
| „ 27 | 8·2 |
| July 4 | 8·6 |
| „ 16 | 8·8 |
| „ 29 | 9·7 |
| Aug. 5 | 10·0 |
| „ 7 | 10·0 |
| „ 18 | 11·0 |
| Sept. 3 | 11·5 |
| „ 5 | 11·5 |
| „ 8 | 11·8 |
| „ 14 | 12·0 |
| „ 29 | 12·6 |
| Oct. 3 | 12·8 |
| „ 29 | 12·0 |
| Nov. 6 | 11·8 |
| „ 10 | 11·3 |
| „ 24 | 11·3 |
| Dec. 7 | 10·3 |
| „ 13 | 9·6 |
| „ 18 | 9·4 |
| „ 21 | 8·8 |
| „ 27 | 8·5 |
| „ 29 | 8·4 |
| 1894—Jan. 2 | 8·2 |

### α HERCULIS.

| | |
|---|---|
| 1893—Aug. 10 | 3·7 |
| „ 14 | 3·9 |
| „ 17 | 3·5 |
| „ 24 | 3·7 |
| „ 31 | 4·0 |
| Sept. 2 | 4·0 |
| „ 4 | 4·0 |
| „ 5 | 4·0 |
| „ 8 | 3·8 |
| „ 13 | 3·6 |
| „ 15 | 3·9 |
| „ 29 | 3·7 |
| Oct. 2 | 3·7 |
| „ 7 | 3·7 |
| „ 13 | 3·4 |
| „ 28 | 3·3 |
| „ 29 | 3·3 |
| Nov. 2 | 3·3 |
| „ 3 | 3·4 |
| „ 10 | 3·3 |
| „ 24 | 3·3 |

### Y OPHIUCHI.

| | |
|---|---|
| 1893—May 19 | 6·2 |
| „ 27 | 6·2 |
| July 21 | 6·0 |
| „ 23 | 6·2 |
| „ 31 | 6·5 |
| Aug. 2 | 6·8 |
| „ 6 | 6·2 |
| „ 7 | 6·0 |
| „ 8 | 6·0 |
| „ 10 | 6·2 |
| „ 11 | 6·2 |
| „ 12 | 6·3 |
| „ 13 | 6·2 |
| „ 14 | 6·2 |
| „ 15 | 6·8 |
| „ 17 | 6·5 |
| „ 18 | 6·5 |
| „ 18 | 6·5 |
| „ 19 | 6·5 |
| „ 21 | 6·2 |
| „ 21 | 6·4 |
| „ 24 | 6·0 |
| Sept. 1 | 6·4 |
| „ 2 | 6·5 |
| „ 4 | 6·5 |
| „ 4 | 6·4 |
| „ 5 | 6·5 |
| „ 13 | 6·4 |
| „ 13 | 6·3 |
| „ 29 | 6·4 |
| Oct. 2 | 6·4 |

### R SCUTI.

| | |
|---|---|
| 1893—July 2 | 5·7 |
| „ 6 | 5·9 |
| „ 11 | 6·2 |
| „ 14 | 6·1 |
| „ 19 | 6·2 |
| „ 21 | 6·2 |
| „ 24 | 6·2 |
| „ 28 | 6·1 |
| „ 31 | 6·1 |
| Aug. 2 | 6·0 |
| „ 5 | 5·8 |
| „ 6 | 6·1 |
| „ 7 | 5·9 |
| „ 8 | 5·7 |
| „ 10 | 5·8 |
| „ 11 | 5·9 |
| „ 12 | 5·8 |
| „ 13 | 5·8 |
| „ 14 | 5·8 |
| „ 15 | 5·8 |
| „ 17 | 5·9 |
| „ 18 | 5·5 |
| „ 19 | 5·5 |
| „ 21 | 5·5 |
| „ 21 | 5·5 |
| „ 24 | 5·3 |

| | |
|---|---|
| 1893—Sept. 1 | 5·5 |
| „ 2 | 5·5 |
| „ 3 | 5·3 |
| „ 4 | 5·3 |
| „ 5 | 5·3 |
| „ 8 | 5·3 |
| „ 13 | 5·7 |
| „ 15 | 5·8 |
| „ 28 | 5·4 |
| Oct. 2 | 5·5 |
| „ 3 | 5·8 |
| „ 7 | 6·1 |
| „ 13 | 6·2 |
| „ 19 | 6·5 |
| „ 19 | 6·4 |
| „ 28 | 6·3 |
| „ 29 | 6·3 |
| Nov. 2 | 5·8 |
| „ 3 | 6·1 |
| „ 10 | 5·5 |
| „ 11 | 5·5 |
| „ 15 | 5·5 |
| „ 20 | 5·3 |
| „ 24 | 5·3 |
| „ 26 | 5·3 |
| Dec. 4 | 5·5 |
| „ 5 | 5·5 |
| „ 13 | 5·8 |

### — AQUILÆ.

h m
1893 18 44
−8 2

| | |
|---|---|
| 1893—Sept. 15 | 7·1 |
| Oct. 28 | 7·2 |
| Dec. 5 | 7·3 |

### — AQUILÆ.

h m
A.R. 1900 18 59·1
P. „ 5° 50′

| | |
|---|---|
| 1893—June 27 | 7·0 |
| July 2 | 6·6 |
| „ 6 | 6·8 |
| „ 14 | 7·1 |
| „ 19 | 7·1 |
| „ 21 | 7·1 |
| „ 24 | 6·5 |
| „ 31 | 7·1 |
| Aug. 2 | 7·1 |
| „ 5 | 6·5 |
| „ 6 | 6·5 |
| „ 7 | 6·5 |
| „ 11 | 7·1 |
| „ 12 | 7·1 |
| „ 13 | 7·2 |
| „ 14 | 7·1 |
| „ 15 | 7·1 |
| „ 17 | 7·1 |
| „ 18 | 7·1 |
| „ 19 | 7·1 |



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| | |
|---|---|
| 1893—Aug. 31 | 7·6 |
| Sept. 1 | 7·6 |
| „ 2 | 7·7 |
| „ 3 | 7·7 |
| „ 4 | 7·6 |
| „ 5 | 7·6 |
| „ 8 | 7·7 |
| „ 13 | 8·0 |
| „ 15 | 7·8 |
| „ 28 | 8·0 |
| Oct. 2 | 7·9 |
| „ 3 | 7·9 |
| „ 6 | 8·1 |
| „ 7 | 8·0 |
| „ 13 | 8·1 |
| „ 13 | 7·8 |
| „ 19 | 7·6 |
| „ 28 | 7·4 |
| „ 29 | 7·6 |
| Nov. 2 | 7·7 |
| „ 3 | 7·6 |
| „ 6 | 7·6 |
| „ 6 | 7·6 |
| „ 10 | 7·3 |
| „ 11 | 7·4 |
| „ 15 | 7·3 |
| „ 24 | 7·6 |
| „ 26 | 7·0 |
| Dec. 4 | 7·1 |
| „ 5 | 7·1 |
| „ 6 | 7·3 |
| „ 10 | 7·1 |
| „ 13 | 7·1 |

### T SAGITTARII.

| | |
|---|---|
| 1893—Oct. 13 | 9·2 |
| „ 23 | 11·5 |
| Nov. 2 | 12·· |

### R SAGITTARII.

| | |
|---|---|
| 1893—Oct. 13 | 7·8 |
| „ 23 | 7·9 |
| Nov. 2 | 8·1 |

### Z SAGITTARII.

| | |
|---|---|
| 1803—Aug. 21 | 9·8 |
| Oct. 13 | 12·0 |
| „ 23 | 11·0 |
| Nov. 2 | 12·0 |

### S SAGITTARII.

| | |
|---|---|
| 1893—Oct. 13 | 12·5 |
| „ 23 | Invis. |
| Nov. 2 | 9·5 |

### χ CYGNI.

| | |
|---|---|
| 1893—Oct. 9 | 6·8 |
| „ 13 | 6·0 |
| „ 16 | 5·5 |
| „ 17 | 5·5 |
| „ 19 | 5·2 |
| „ 20 | 5·2 |
| „ 23 | 5·0 |
| „ 25 | 4·8 |
| „ 26 | 4·6 |
| „ 28 | 4·8 |
| „ 28 | 4·6 |
| „ 29 | 4·7 |
| „ 29 | 4·6 |
| Nov. 2 | 4·8 |
| „ 2 | 4·6 |
| „ 3 | 4·5 |
| „ 5 | 4·3 |
| „ 6 | 4·3 |
| „ 7 | 4·5 |
| „ 9 | 4·5 |
| „ 10 | 4·4 |
| „ 11 | 4·4 |
| „ 13 | 4·5 |
| „ 20 | 4·6 |
| „ 24 | 4·7 |
| „ 26 | 4·7 |
| Dec. 4 | 5·2 |
| „ 5 | 5·0 |
| „ 7 | 5·2 |
| „ 10 | 5·3 |
| „ 13 | 5·5 |
| „ 14 | 5·5 |
| „ 17 | 5·7 |
| „ 18 | 5·8 |
| „ 19 | 5·9 |
| „ 20 | 5·9 |
| „ 21 | 6·0 |
| „ 27 | 6·1 |
| „ 29 | 6·3 |
| 1894—Jan. 2 | 6·4 |
| „ 13 | 7·3 |

### S2 CYGNI.

| | |
|---|---|
| 1893—Dec. 7 | 7·3 |
| „ 10 | 7·4 |
| „ 13 | 7·0 |
| „ 19 | 7·4 |
| „ 27 | 7·3 |

### P 34 CYGNI.

| | |
|---|---|
| 1893—Aug. 7 | 4·84 |
| Sept. 20 | 5·04 |
| Oct. 3 | 4·94 |
| „ 9 | 5·04 |
| „ 13 | 5·04 |
| „ 19 | 4·87 |
| 1893—Oct. 20 | 4·84 |
| „ 23 | 4·84 |
| „ 28 | 4·74 |
| Nov. 3 | 4·84 |
| „ 6 | 4·84 |
| „ 7 | 4·84 |

### S CYGNI.

| | |
|---|---|
| 1892—Nov. 25 | 10·2 |
| 1893—May 14 | 11·0 |
| „ 17 | 11·0 |
| „ 18 | 11·0 |
| Dec. 29 | 11·0 |

### X CYGNI.

| | |
|---|---|
| 1893—Sept. 20 | 6·6 |
| Oct. 3 | 7·5 |
| „ 9 | 6·4 |
| „ 13 | 6·4 |
| „ 19 | 7·3 |
| „ 20 | 7·4 |
| „ 23 | 6·6 |
| „ 28 | 6·4 |
| „ 29 | 6·4 |
| Nov. 3 | 6·8 |
| „ 5 | 7·3 |
| „ 6 | 7·3 |
| „ 7 | 7·0 |
| „ 10 | 6·2 |
| „ 13 | 6·4 |
| Dec. 5 | 6·8 |
| „ 7 | 7·2 |
| „ 10 | 6·9 |
| „ 13 | 6·2 |
| „ 27 | 6·5 |
| „ 29 | 6·3 |
| 1894—Jan. 2 | 6·3 |

### — AQUARII.

| | h | m |
|---|---|---|
| A.R. 1900 | 20 | 41·2 |
| D. „ | −4 | 26 |

| | |
|---|---|
| 1893—Sept. 3 | Invis. |
| „ 28 | Invis. |
| Oct. 2 | Invis. |
| „ 6 | Invis. |
| Nov. 2 | 10·5 |
| Dec. 10 | 8·7 |

### RR CYGNI.

| | |
|---|---|
| 1892—Aug. 9 | 8·8 |
| „ 12 | 9·5 |
| „ 21 | 9·6 |
| Nov. 25 | 9·3 |
| 1893—Jan. 10 | 9·6 |
| April 26 | 9·5 |



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| | | |
|---|---|---|
| 1893—May | 27 | 9·6 |
| June | 6 | 9·5 |
| „ | 12 | 9·5 |
| „ | 20 | 9·6 |
| „ | 30 | 9·6 |
| July | 6 | 9·5 |
| „ | 14 | 9·5 |
| „ | 23 | 9·1 |
| „ | 24 | 9·1 |
| „ | 29 | 9·3 |
| „ | 29 | 8·8 |
| Aug. | 2 | 9·3 |
| „ | 5 | 9·2 |
| „ | 7 | 8·7 |
| „ | 13 | 9·5 |
| Oct. | 13 | 9·3 |
| „ | 29 | 9·2 |
| Nov. | 2 | 9·2 |
| „ | 6 | 9·2 |
| „ | 10 | 9·3 |
| „ | 24 | 9·5 |
| Dec. | 7 | 9·5 |
| „ | 10 | 9·5 |
| „ | 19 | 9·6 |
| „ | 21 | 9·5 |
| „ | 29 | 9·5 |
| 1894—Jan. | 2 | 9·2 |

## T CYGNI.

| | | |
|---|---|---|
| 1893—Aug. | 5 | 5·2 |
| „ | 7 | 5·2 |
| Sept. | 30 | 5·0 |
| Oct. | 3 | 5·0 |
| „ | 9 | 5·7 |
| „ | 13 | 5·0 |
| „ | 19 | 5·2 |
| „ | 20 | 5·0 |
| „ | 23 | 5·1 |
| „ | 28 | 5·0 |
| „ | 29 | 5·2 |
| Nov. | 3 | 5·1 |
| „ | 7 | 5·1 |
| „ | 24 | 5·1 |

## Y CYGNI.

| | | |
|---|---|---|
| 1893—Oct. | 3 | 7·65 |
| „ | 9 | 7·72 |
| „ | 13 | 7·4 |
| „ | 13 | 7·4 |
| „ | 19 | 7·6 |
| „ | 19 | 7·6 |
| „ | 19 | 7·8 |
| „ | 20 | 7·5 |
| „ | 23 | 7·7 |
| „ | 28 | 7·6 |
| „ | 29 | 7·6 |
| Nov. | 3 | 7·3 |
| „ | 5 | 7·7 |
| „ | 6 | 7·4 |
| „ | 7 | 7·1 |
| 1893—Nov. | 10 | 7·4 |
| „ | 13 | 7·4 |
| Dec. | 5 | 7·9 |
| „ | 7 | 7·3 |
| „ | 10 | 7·6 |
| „ | 27 | 7·6 |
| „ | 29 | 7·7 |
| „ | 29 | 7·65 |
| „ | 29 | 7·76 |
| „ | 29 | 7·76 |
| „ | 29 | 7·90 |
| „ | 29 | 7·76 |
| „ | 29 | 7·65 |
| 1894—Jan. | 2 | 7·5 |

## 32 VULPECULÆ.

| | | |
|---|---|---|
| 1893—Dec. | 13 | 5·1 |

## X CAPRICORNI.

| | | |
|---|---|---|
| 1883—Sept. | 1 | Invis. |
| „ | 2 | „ |
| „ | 3 | „ |
| „ | 13 | „ |
| „ | 14 | „ |
| „ | 29 | „ |
| Oct. | 2 | „ |
| „ | 6 | „ |
| „ | 13 | „ |
| „ | 28 | 13·0 |
| „ | 29 | 13·0 |
| Nov. | 2 | 12·5 |
| „ | 24 | 12·0 |

## — CAPRICORNI.

| | h | m |
|---|---|---|
| A.R. 1893, | 21 | 4·34 |
| D. „ | −16 | 3·7 |

| | | |
|---|---|---|
| 1893—Oct. | 28 | 10·0 |

## T CEPHEI.

| | | |
|---|---|---|
| 1893—Sept. | 8 | 6·0 |
| „ | 14 | 5·9 |
| Oct. | 3 | 6·6 |
| „ | 29 | 7·0 |
| Nov. | 7 | 8·2 |
| „ | 10 | 8·2 |
| Dec. | 13 | 8·5 |
| „ | 21 | 8·5 |
| „ | 27 | 9·4 |
| 1894—Jan. | 2 | 9·5 |

## Y CAPRICORNI.

| | | |
|---|---|---|
| 1893—Sept. | 3 | 12·0 |
| „ | 14 | 11·5 |
| „ | 29 | Invis. |
| Oct. | 2 | „ |
| „ | 6 | ? |
| „ | 13 | Invis. |
| Nov. | 12 | „ |
| Dec. | 10 | „ |
| 1894—Jan. | 4 | „ |

## S CEPHEI.

| | | |
|---|---|---|
| 1892—June | 7 | Not identified. |
| 1893—May | 14 | 10·0 |
| „ | 17 | 10·0 |
| „ | 18 | 10·0 |
| „ | 21 | 10·1 |
| June | 2 | 10·0 |
| „ | 13 | 10·0 |
| July | 4 | 10·0 |
| „ | 16 | 9·8 |
| „ | 29 | 10·0 |
| Aug. | 5 | 10·0 |
| „ | 7 | 10·0 |
| Sept. | 3 | 10·4 |
| „ | 8 | 11·0 |
| „ | 14 | 11·0 |
| Oct. | 3 | 11·2 |
| Dec. | 13 | 11·6 |
| „ | 27 | 11·8 |

## 29 U.A. PISCIS AUSTRALIS.

| | | |
|---|---|---|
| 1893—June | 9 | 5·2 |
| „ | 12 | 5·2 |
| „ | 17 | 5·3 |
| July | 16 | 5·3 |
| „ | 21 | 5·0 |
| „ | 22 | 5·0 |
| „ | 23 | 5·0 |
| „ | 31 | 5·0 |
| Aug. | 7 | 5·4 |
| „ | 10 | 5·4 |
| „ | 15 | 5·4 |
| „ | 17 | 5·3 |
| „ | 18 | 5·3 |
| Sept. | 3 | 5·3 |
| „ | 20 | 5·1 |
| Oct. | 2 | 5·5 |
| „ | 3 | 5·6 |
| „ | 6 | 5·4 |
| „ | 7 | 5·3 |
| „ | 13 | 5·4 |
| „ | 19 | 5·1 |
| „ | 22 | 5·4 |
| „ | 23 | 5·4 |
| „ | 28 | 5·4 |
| Nov. | 2 | 5·3 |
| „ | 3 | 5·1 |



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| | |
|---|---|
| 1893—Nov. 6 | 5·4 |
| „ 11 | 5·3 |
| „ 15 | 5·4 |
| „ 24 | 5·3 |
| Dec. 5 | 5·3 |
| „ 27 | 5·4 |
| 1894—Jan. 2 | 5·4 |

R CASSIOPEIÆ.

| | |
|---|---|
| 1892—July 28 | 8·7 |
| Aug. 21 | 9·1 |
| Sept. 21 | 9·9 |
| 1893—Feb. 12 | 10·0 |
| June 17 | 7·3 |
| July 4 | 7·5 |
| „ 6 | 7·8 |
| „ 14 | 7·4 |
| „ 21 | 7·4 |
| „ 23 | 7·8 |
| Aug. 5 | 8·4 |
| „ 7 | 8·3 |
| „ 17 | 8·7 |
| Sept. 1 | 8·6 |
| „ 8 | 9·3 |
| „ 29 | 9·5 |
| 1893—Oct. 8 | 9·6 |
| „ 29 | 9·6 |
| Nov. 3 | 9·7 |
| Dec. 13 | 10·3 |
| „ 27 | 10·6 |

— CASSIOPEIÆ.

| | h | m |
|---|---|---|
| A.R. 1893, | 23 | 56·2 |
| D. „ | +59 | 51·2 |

| | |
|---|---|
| 1893—Dec. 13 | 7·2 |
| „ 18 | 7·0 |

## SUMMARY OF OBSERVATIONS OF VARIABLE STARS.

| Name. | A.R. 1900. | Dec. 1900. | Obs. |
|---|---|---|---|
| | h m | | |
| T Cassiopeiæ | 0 17·8 | +55 14 | 46 |
| S Piscium | 1 12·3 | + 8 24 | 11 |
| S Cassiopeiæ | 1 12·3 | +72 5 | 8 |
| — Piscium | 1 15·9 | + 9 7 | 10 |
| | 1893 | 1893 | |
| R Sculptoris | 1 22·4 | −33 4 | 1 |
| T Persei | 2 12·2 | +58 29 | 18 |
| o Ceti | 2 14·3 | − 3 26 | 57 |
| S Persei | 2 15·7 | +58 8 | 18 |
| — Tauri | 3 47·5 | + 7 28 | 6 |
| | 1893 | 1893 | |
| λ Tauri | 3 55·1 | +12 12 | 15 |
| R Eridani | 4 50·5 | −16 35 | 8 |
| | 1893 | 1893 | |
| R Leporis | 4 55 | −14 57 | 25 |
| R Aurigæ | 5 9·2 | +53 29 | 10 |
| α Orionis | 5 49·7 | + 7 23 | 7 |
| R Lyncis | 6 53·1 | +35 29 | 2 |
| R Puppis | 7 36·7 | −31 25 | 1 |
| | 1893 | 1893 | |
| — Leonis | 9 40·5 | + 7 12 | 3 |
| | 1893 | 1893 | |
| R Leonis | 9 44·2 | +11 54 | 36 |
| U Hydræ | 10 32·6 | −12 52 | 36 |
| R Urs. Maj | 10 37·7 | +69 18 | 34 |
| T Urs. Maj. | 12 31·9 | +60 3 | 42 |
| S Urs. Maj. | 12 39·6 | +61 39 | 41 |
| R Hydræ | 13 24·2 | −22 46 | 18 |
| S Bootis | 14 19·5 | +54 16 | 11 |
| — Bootis | 14 22·3 | + 5 7 | 2 |
| R Camel. | 14 25·1 | +84 17 | 50 |
| V Bootis | 14 25·7 | +39 18 | 1 |
| Z Scorpii | 16 0·1 | −21 28 | 4 |
| R Urs. Min. | 16 31·3 | +72 29 | 42 |
| R Draconis | 16 32·4 | +66 58 | 44 |
| α Herculis | 17 10·1 | +14 30 | 21 |
| Y Ophiuchi | 17 47·3 | − 6 7 | 31 |
| R Scuti | 18 42·1 | − 5 49 | 55 |
| — Aquilæ | 18 44·0 | − 8 2 | 3 |
| | 1893 | 1893 | |
| — Aquilæ | 18 59 1 | − 5 50 | 52 |
| T Sagittarii | 19 10·5 | −17 9 | 3 |
| R Sagittarii | 19 10·8 | −19 29 | 3 |
| Z Sagittarii | 19 13·8 | −21 7 | 4 |
| S Sagittarii | 19 13·6 | −19 13 | 3 |
| χ Cygni | 19 46·7 | +32 40 | 41 |
| S2 Cygni | 20 9·5 | +38 23 | 5 |
| P(34) Cygni | 20 14·1 | +37 43 | 12 |
| S Cygni | 20 34·4 | +57 42 | 5 |
| X Cygni | 20 39·5 | +35 13 | 22 |
| — Aquarii | 20 41·2 | − 4 26 | 6 |
| RR Cygni | 20 42·6 | +44 30 | 33 |
| T Cygni | 20 32·2 | +34 0 | 14 |
| Y Cygni | 20 48·0 | +34 17 | 29 |
| 32 Vulpeculæ | 20 50·0 | +30 0 | |
| | 1893 | 1893 | |
| X Capricorni | 21 2·8 | −21 45 | 13 |
| — Capricorni | 21 4·6 | −16 37 | 1 |
| | 1893 | 1893 | |
| T Cephei. | 21 8·2 | +68 5 | 10 |
| Y Capricorni | 21 28·9 | −14 25 | 9 |
| S Cephei. | 21 36·5 | +78 10 | 18 |
| 29 U.A. Piscis Aust. | 22 2·6 | −34 37 | 33 |
| | 1875 | 1875 | |
| R Cassiopeiæ | 23 53·3 | +50 50 | 21 |
| — Cassiopeiæ | 23 56 | +59 51 | 2 |
| | 1893 | 1893 | |



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OBSERVATIONS of R LEONIS in 1893. (Maximum, according to to "Annuaire," July 4, 1893. Minimum do., Feb. 6, 1893. Period, 312d 9.) Comparison in grades. One grade = 0·14 mag. Local times.

| Month and Day. | Hour. | Comparison. | | Mean Mag. adopted. | Bar. | Therm. | Observation. |
|---|---|---|---|---|---|---|---|
| | | V > * | * > V | | | | |
| 1893. | h m | | | | in. | ° | |
| Mar. 12 | 8 40 | V 1 *c* | *a* 1 V | 9·2 | — | — | Hazy. V ruddy colour. |
| 20 | 8 10 | V 1 *b* | *a* 1 V | 9·1 | — | — | Do. Rather difficult. |
| April 3 | 12 35 | V 2 *a* | *a'* 2 V | 8·8 | — | — | Moonlight. Fine. V clear red. |
| 26 | 11 5 | V = *a''* | — | 7·4 | 30·24 | 58 | Strong N.N.E. moonlight. Image of stars boiling. |
| May 5 | 11 45 | V 1 *d* | *a''* 2 V | 7·8 | 29·93 | 56 | |
| 9 | 11 15 | V 1 *a''* | Fl. 19 3 V | 7·2 | — | — | Somewhat doubtful. |
| 12 | 10 50 | V 1 *a''* | Fl. 19 3 V | 7·2 | 30·06 | 58 | Do. cloudy. |
| 13 | 9 0 | V 1 *a''* | Fl. 19 3 V | 7·2 | 30·00 | 59 | Fine. |
| 14 | 8 38 | V 1 *a''* | Fl. 19 3 V | 7·2 | — | — | |
| 17 | 9 45 | V 1 *a''* | *e* 1 V | 7·1 | 30·00 | 60 | Binocular. |
| 18 | 9 40 | V 1 *a''* | *e* 1 V | 7·1 | 30·08 | 58 | Do. Hazy. Fine night. Moon 3 days; near setting; very sure. |
| 19 | 8 20 | V 2 *a''* | *e* 1 V | 7·0 | 30·18 | 60 | Sure. |
| 27 | 8 40 | V 2 *a''* | *e* 1 V | 7· | 29·80 | 62 | Moon 12 days. Fair night. Binocular and 4-in., with 40 wedge photometer. Very sure. |
| 28 | 9 50 | V = *e* | — | 6·8 | 29·90 | 61 | |
| 31 | 10 30 | V 1 *e* | Fl. 19 2 V | 6·7 | 30·22 | 63 | Moon rising. Fine. |
| June 1 | 8 50 | V 2 *e* | Fl. 19 1 V | 6·5 | 30·24 | 64 | |
| 2 | 9 8 | V 1 *e* | Fl. 19 2 V | 6·7 | 30·20 | 64 | Rather hazy. Quiet night. |
| 6 | 9 30 | V 2 *e* | Fl. 19 1 V | 6·6 | — | — | Hazy, but very sure. Wedge. |
| 9 | 9 0 | V 2 Fl. 19 | Fl. 18 2 V | 6·3 | 29·70 | 62 | Binocular. |
| 9 | 9 15 | V = Fl. 19 | — | 6·4 | — | — | Wedge. |
| 10 | 9 20 | V 1 Fl. 19 | Fl. 18 3 V | 6·4 | — | — | Binocular. |
| 13 | 9 20 | V = F. 19 | — | 6·4 | 30·22 | 64 | Hazy. Eye-piece 20. |
| 14 | 9 5 | V = F. 19 | — | 6·4 | — | — | Fine night. Wedge. |
| 15 | 8 12 | V = Fl. 18 | — | 6·1 | 30·30 | 64 | Moon 2 days. Twilight. |
| 15 | 8 25 | V = Fl. 18 | — | 6·1 | — | — | Power 160; definition very good. |
| 17 | 8 50 | V 1 Fl. 18<br>V = 10 = | *v* 2 V<br>5·95 | —<br>5·9 | 30·18<br>— | 63<br>— | Moon 3 days. Near by. |
| 20 | 8 50 | V = Fl. 18 | — | 6·1 | 29·75 | 62 | „ 7 „ Cloudy. |
| 27 | 8 45 | V 3 Fl. 18 | *v* 2 V | 5·6 | 30·20 | 66 | „ 14 „ Difficult. |
| July 2 | 8 45 | V 4 Fl. 18 | — | 5·5 | 30·13 | 64 | V rather low. Little difference in binocular, but power 160 gives the star decidedly brighter. |
| 4 | 8 30 | V fainter than *v*, and about two grades brighter than Fl. 18. | | | | | Difficult. |



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Instruments employed: $4\frac{1}{2}$-in. refractor; powers 20, 40, 100, and occasionally 160. Binocular $2\frac{1}{8}$-in. Naked eye when possible. Estimation of the magnitudes of the comparison stars *a'*, *a*, *b*, *c*, not given in the Harvard photometry, by comparison with *b'*, *l*, *m*, *n*, and *p*.

| | *a'* | *a* | *b* | *c* |
|---|---|---|---|---|
| June 2 - - | 8·9 | 9·1 | 9·3 | 9·5 |
| 6, 9 - - | 8·6 | 8·9 | 9·0 | 9·2 |
| 15 - - | — | 8·9 | 9·2 | 9·4 |
| July 2 - - | — | 9·0 | 9·3 | 9·4 |
| | 8·70 | 8·97 | 9·20 | 9·37 mean magnitudes. |

The Harvard photometry gives *Fl* 18 = 6·10 and *Fl* 19 = 6·30. I find the difference of 0·2 between them very small, and I have estimated the latter = 6·5; but now I think that it would have been more in accordance with the H. scale to have made *Fl* 18 = 5·9 . . . . . ?

OBSERVATIONS of U Hydræ in 1893. Comparisons in grades. One grade = 0·14 mag.

| Month and Day. | Hour. | Comparison. V > * | Comparison. * > V | Mean Mag. adopted. | Barometer. | Thermometer. | General Remarks on the Observation. |
|---|---|---|---|---|---|---|---|
| 1893. | h m | | | | | | |
| April 5 | 10 6 | V = *a* | $\phi^2$ 2 V | 5·6 | 30·34 | 56 | Bad seeing. |
| 6 | 8 30 | V = *a* | $\phi^2$ 2 V | 5·6 | 50·03 | 52 | |
| 9 | 9 40 | V 2 *a* | $\phi^2$ 1 V | 5·3 | 29·50 | 62 | Hazy. Doubtful. |
| 9 | 10 10 | V = $\phi^2$ | — | 5·3 | — | — | Naked eye. Sure. |
| 16 | 8 5 | V = $\phi^2$ | — | 5·3 | — | — | Hazy. Pretty sure. |
| 18 | 12 15 | V 1 *d* | $\phi^2$ 2 V | 5·5 | 30·06 | 58 | Do. do. |
| 20 | 8 55 | V = *a* | — | 5·7 | 30·18 | 57 | Do. do. moon 4 days. |
| 24 | 7 50 | V = $\phi^2$ | — | 5·2 | 30·08 | 58 | Moon 8 days. |
| May 1 | 8 10 | V 2 *a* | $\phi^2$ 1 V | 5·3 | — | — | Hazy. Moon full, but low and covered with clouds. |
| 4 | 8 34 | V = $\phi^2$ | — | 5·2 | 29·82 | 61 | Hazy. No moon. |
| 4 | 9 20 | V 2 *a* | $\phi^2$ 1 V | 5·3 | — | — | |
| 5 | 9 30 | V 2 *a* | $\phi^2$ 1 V | 5·3 | 29·94 | 57 | Sure. Fine night. |
| 7 | 8 50 | V 1 *a* | $\phi^2$ 2 V | 5·5 | — | — | Cloudy. Pretty sure. |
| 9 | 11 20 | V 2 *a* | $\phi^2$ 1 V | 5·3 | — | — | Do. do. |
| 10 | 8 25 | V 2 *a* | $\phi^2$ 1 V | 5·3 | 30·28 | 61 | Do. do. |
| 13 | 8 30 | V 2 *a* | $\phi^2$ 1 V | 5·3 | 30·00 | 59 | Fine night. Very sure. |
| 14 | 8 27 | V 1 *a* | $\phi^2$ 2 V | 5·5 | — | — | |



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| Month and Day. | Hour. | Comparison. V > * | Comparison. * > V | Mean Mag. adopted. | Barometer. | Thermometer. | General Remarks on the Observation. |
|---|---|---|---|---|---|---|---|
| 1893. | h m | | | | | | |
| 17 | 8 30 | V 1 $a$ | $\phi^2$ 2 V | 5·5 | 30·00 | 60 | Very sure. Naked eye. |
| 18 | 9 40 | V 1 $a$ | $\phi^2$ 2 V | 5·5 | 30·08 | 60 | Do. do. hazy. |
| 19 | 8 30 | V 1 $a$ | $\phi^2$ 3 V | 5·5 | 30·18 | 60 | Moon 3 days, near setting. |
| 26 | 8 45 | V = $\phi^2$ | — | 5·2 | 29·90 | 62 | Moon 11 days. Rather too near. Hazy and unsteady. |
| 27 | 8 58 | V = $\phi^2$ | — | 5·2 | 29·80 | 62 | Fair. V red orange. Colour makes it brighter than it really is. |
| 28 | 8 50 | V 1 $\phi^2$ | $\alpha$ Crateris 3 V | 4·9 | — | — | |
| 28 | 9 40 | V 2 $\phi^2$ | $\mu$ 3 V | 4·7 | 29·94 | 61 | |
| 31 | 8 22 | V 2 $a$ | $\phi^2$ 1 V | 5·3 | 30·22 | 63 | Fine. Too clear yet. |
| June 1 | 8 50 | V = $\phi^2$ | — | 5·2 | 30·24 | 64 | |
| 2 | 8 15 | V 3 $\phi^2$ | $\mu$ 4 V | — | 30·20 | 64 | Twilight. Hazy. |
| 2 | 8 50 | V 2 $a$ | $\phi^2$ 2 V | 5·0 | — | — | |
| 4 | 9 5 | V 2 $a$ | $\phi^2$ 2 V | 5·5 | 30·20 | 65 | |
| | | V = $b^1$ | — | | | | |
| | | V 1 $d$ | — | | | | |
| 6 | 9 25 | V = $a$ | — | 5·7 | 30·30 | 64 | Hazy. Rather low. |
| 9 | 9 0 | V 1 $a$ | $\phi^2$ 2 V | 5·5 | 29·70 | 62 | Difficult. |
| | | V = $b^1$ | | | | | |
| 10 | 8 50 | V 1 $a$ | $\phi^2$ 2 V | 5·5 | 29·90 | 62 | Good. |
| 13 | 9 20 | V = $\phi^2$ | — | 5·2 | 30·26 | 62 | Rather low. |
| 14 | 9 0 | V 2 $a$ | $\phi^2$ 1 V | 5·3 | 30·25 | 62 | Fine night. Binocular and naked eye. |
| 15 | 8 30 | V 2 $\phi^2$ | $\mu$ 4 V | 4·7 | 30·30 | 64 | Twilight. Yet sure. |
| 17 | 8 45 | V = $\phi^2$ | — | 5·2 | 30·18 | 63 | Rather low. Moon 3 days. |

COMPARISON STARS, with approximate Mean Places for 1880. Harvard Photometry.

| | | A.R. 1880. | P. 1880. | Mag. |
|---|---|---|---|---|
| | | h m | ° ′ | |
| Hydræ | Sextans $a$ | 10 25·1 | −12 59 | 5·68 |
| | $\phi^2$ | 10 32 7 | −16 15 | 5·16 |
| | $d$ | 10 44·3 | − 8 16 | 5·75 |
| | $\mu$ | 10 20 3 | −16 13 | 4·14 |
| | $b^1$ | 10 41·0 | −16 40 | 5·40 |
| Crateris | $a$ | 10 53·9 | −17 40 | 4·09 |

Binocular and naked eye, and sometimes 4¼ refractor. Powers 20, 40, 100, and 160, occasionally with small wedge of coloured glass (neutral tint).



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With reference to the search for "new" or "temporary" stars, the portion of the sky in and near the Milky Way visible in northern latitudes was divided among the observers who agreed to take part in the search. A sketch map of the region allotted to each observer was supplied, showing all the stars given in Heis' Atlas (of which the faintest are 6·7 mag. ($6\frac{1}{2}$), the limit of brightness adopted). Some of the observers have watched their portions very carefully, but nothing new has been found. It seems probable, therefore, that "temporary" stars of 6th magnitude and brighter are exceedingly rare objects. Below the 6th or 7th magnitude they may, possibly, be of more frequent occurrence, but a search for these faint stars would require a large number of observers.—J. E. G.

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# SECTION FOR THE OBSERVATION

OF

# THE SUN.

DIRECTOR.—MISS E. BROWN.

## THIRD REPORT OF THE SECTION, 1893.

### Introduction.

The accompanying report of the work of the Solar Section for 1893 follows the same lines as those adopted for the previous year. The fact that it includes the culmination of the sun-spot maximum period, and also the unprecedented fineness of the season, which permitted almost constant observations, have combined to render it more voluminous than usual, and it is hoped, more interesting.

The "Calendar," it will be seen, gives the number of groups visible on each day of the year, including a few very small spots which are not numbered; also the position of some of the most remarkable faculæ. These, it may be observed, have shown a decline rather than an increase, in contra-distinction to the spots themselves.

The "Ledger" gives the detailed history of each group for every day, and also their mean heliographic latitudes and longitudes.

Tables and diagrams of position have been supplied regularly throughout the year by Mr. J. S. Townsend and the Rev. F. J. Eld, and have been admirably supplemented by Prof. Pereira, of the Azores, who has also included areas and excellent sketches, thus enabling the Director to fill up many missing dates which would otherwise have remained blank.

The engravings appended have been specially chosen this time to illustrate the rapid changes which take place in some spots. Their proper motion in latitude and longitude is now undisputed, and has been ably treated of in a valuable article in the September number of "Knowledge" (p. 94), entitled "The Wanderings of a Sun-spot."



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In close connexion with this proper motion is the question which has already been referred to in a query propounded to the Members of the Solar Section in the "Journal," relative to the turning round of spots. An entire rotation does not seem to have been proved, although instances of a partial one are common, as in Groups 219 and 232 (*see* Ledger).

A paper in "L'Astronomie" (November 1894) shows that this subject has been of late under consideration by M. Flammarion, who, as the result of recent observations, regards the rotation of the nuclei of spots, on an axis normal to the surface, as an established fact. Some notes supplied by Prof. Pereira in the month of April in the present year confirm this theory, and may be summarised here. He describes one of the two largest nuclei in a large group in longitude 31°, latitude 20° N., as turning round its companion nucleus (situated to the N. of it) as on a pivot, the motion continuing for several days and becoming complete by the time of its approach to the W. limb. My own drawings do not entirely bear this out, but that considerable proper motion was involved, in which the penumbra, as well as the nucleus participated, is undoubted.

Plates I. and II. represent a single group which appeared in May. Plates III. and IV. two groups in August and September, which were visible simultaneously, and Plates V. and VI. the large equatorial group of November.

The fine spots observed in July, August, and September have been already illustrated in the "Journal" (Vol. III., No. 11) and in Vol. III., No. 7, under the heading "Some Typical Forms of Sun-spots," is an engraving of a beautiful cluster (Group 14) which was seen in January.

E. BROWN,
October 27, 1894. Director of the Section.

Names of Observers from whom drawings have been received during the year 1893.

| Name. | Address. | Instrument. |
|---|---|---|
| BARTLETT, J. | Bramley | 4-in. O.G. |
| BROWN, MISS E. | Cirencester | 8½-in. O.G. 6½-in. Spec. |
| CORDER, H. | Bridgwater | 6½-in. Spec. |
| ELD, REV. F. J. | Worcester | 8½-in. Spec. |
| PEREIRA, J. DE MORAES | St. Michael's, Azores. | 4¼-in. O.G. |
| POPE, J. T | Dingwall, N.B. | 3-in. O.G. |
| TOWNSEND, J. S. | Sevenoaks | 4½-in. O.G. |
| WAUGH, REV. W. R. | Portland | 4½-in. O.G. |
| WATTS, W. H. | Banbury | 3-in. O.G. |
| WYKES, J. | Birmingham | 4-in. O.G. |



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# Calendar of Sunspots and Faculæ.

## JANUARY 1893.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1. | 1, 2, 3, 4, 5, 6. | Near E. limb, N. and 15° S. |
| 2. | 2, 3, 4, 5, 6, 7, 8, 9. | E. 10° to 23° S., W. 5° to 30° N., 18° to 32° S. |
| 3. | | |
| 4. | 2, 3, 4, 5, 6, 7, 8, 9, 10. | W. 5° N. |
| 5. | | |
| 6. | 3, 4*, 5, 7, 8, 10. | |
| 7. | | |
| 8. | 4*, 5, 7, 8. | |
| 9. | 4*, 8, 11. | |
| 10. | 4*, 8, 11, 12, 13. | E., bright near group 11. S.E., some distance from limb. W. f. group 10, and a patch far S. |
| 11. | 8, 11, 12, 13. | E., s. f. group 11. W. 20° N. and far S. |
| 12. | | |
| 13. | 11, 13. | E., f. group 11 and 13. W. near limb. |
| 14. | 11, 13. | |
| 15. | 11, 13, 14. | E. (region of group 14), very numerous, 9° to 14° S. |
| 16. | | |
| 17. | 11, 13, 14. | |
| 18. | 11, 13, 14. | |
| 19. | | |
| 20. | 14, 15. | W. to the S. |
| 21. | 14, 15, 16, 17. | E. f. group 14 and 16, conspicuous. W. N. of 13. Some more S. |
| 22. | 14, 15, 16, 17. | E. to the S. |
| 23. | 14, 15, 16, 17, 18. | E. 15° to 30° S. |
| 24. | 14, 15, 16, 17, 18, 19, 20. | |
| 25. | 14, 15, 16, 17, 18, 20, 21. | |
| 26. | 14, 15, 16, 18, 20, 21, 22, 23. | |
| 27. | 14, 15, 16, 18, 20, 21, 22, 23. | E. between groups 22 and 23. W. many f. 14. |
| 28. | 16, 18, 20, 21, 22, 23. | |
| 29. | 16, 18, 20, 21, 22, 23. | E. 20° S. W. extensive near and N. of 16. Below 20° S. |
| 30. | 18, 20, 21, 22, 23. | |
| 31. | 18, 20, 21, 22, 23, 24. | |

## FEBRUARY 1893.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1. | 18, 19, 20, 21, 22, 23, 24, 25. | W. very numerous round and p. group 20. |
| 2. | 18, 19, 20, 21, 22, 23, 24, 25. | |
| 3. | | |
| 4. | 18, 21, 22, 23, 24, 25. | E., one or two small patches. Position of 28? |
| 5. | 18, 22, 23, 25, 26, 27, 28. | W. extending from groups 22 to 23. |
| 6. | 18, 22, 23, 25, 26, 27, 28. | S.E. small round. W. between 22 and 23. |
| 7. | 25, 26, 27, 28. | W. S. of 25, and position of 22 and 23. A small spot n. f. 25 not numbered. |
| 8. | 25, 26, 28, 29, 30. | E. 7° N. and f. 28. |
| 9. | | |
| 10. | 28, 29, 30, 31. | E. f. group 30. |
| 11. | 28, 30, 31, 32. | |
| 12. | 28, 30, 31, 32, 33. | E. 32° N., with one small spot. |
| 13. | 28, 30, 31, 32. | |
| 14. | 28, 30, 31, 32. | E. S. of 32. A small bright patch where 34 appeared. A small spot n. f. not numbered. |
| 15. | 28, 30, 31, 32. | |
| 16. | 28, 30, 31, 32, 34. | |
| 17. | 28, 30, 31, 32, 34. | E. N. and S. of 34. |
| 18. | 30, 32, 34, 35, 36. | |
| 19. | 30, 32, 34, 35, 36. | E. 35° S. W. below 40° S. |
| 20. | 30, 32, 34, 35, 36. | E. S. of 26, large. |
| 21. | | |
| 22. | | |
| 23. | 32, 35, 36, 37. | |
| 24. | 35, 36, 37, 38. | |
| 25. | 36, 37, 38. | E. Small patch, 30° S. W. 10° to 20° N. Position of 30. |
| 26. | 36, 37, 38. | E. faint, where group 40 appeared. |
| 27. | | |
| 28. | 36, 37, 38, 39, 40, 41. | |



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## MARCH 1893.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1. | 36, 37, 38, 40, 41. | E. limb, a bright patch f. group 41. |
| 2. | 36, 37, 38, 40, 41. | E., the same patch still visible. W. extensive, p. 37. |
| 3. | | |
| 4. | 37, 38, 41, 42, . | E., 3° to 10° N., with one very small spot. W., many, region of 37. |
| 5. | | |
| 6. | | |
| 7. | 38, 41, 42, 43. | |
| 8. | 41, 42, 43, 44, 45, 46. | |
| 9. | 41, 42, 43, 44, 45 46, 47. | E. p. group 47, and N. of it. |
| 10. | 41, 43, 44, 45, 46. 47, 48, 49. | Numerous round and p. 47. |
| 11. | 44, 45, 47. | |
| 12. | 44, 47. | W. A small but well-defined patch (position of 41?). |
| 13. | 44, 47. | |
| 14. | 47, 50. (Three small spots not numbered). | W. Bright, with one small spot (49?). Large, p. 50. |
| 15. | 47, 50. | E. far from limb. W., N., and S. of 48. |
| 16. | 47, 50. | |
| 17. | 47, 50, 51, 52, 53. | E. great extent, 51, up to limb. |
| 18. | 47, 51, 52, 53. | |
| 19. | 47, 51, 52, 53, 54. | S.E. limb. |
| 20. | 47, 51, 53, 54. | S.E., same position as on the 19th. |
| 21. | 47, 53, 54. | E. 20° S. lat. |
| 22. | 47, 53, 54. | |
| 23. | 53, 54, 55, 56. | E. 20° to 25° S. |
| 24. | 53, 54, 55, 56, 58. | W. imb N. and S. of equator. |
| 25. | 53, 54, 55, 57, 58, 59. | Near S.E. limb, round 57. (Still same position as before). |
| 26. | 53, 54, 55, 57, 58, 59, 60, 61. | |
| 27. | 53, 54, 55, 57, 58, 59, 60, 61, 62, 63. | Well defined patch S. of 59. |
| 28. | 53, 54, 55, 57, 58, 59, 60, 61, 62, 63. | W. p. 53. Surrounding 60, although spots small. |
| 29. | 53, 54, 55, 57, 58, 59, 60, 61, 62, 63. | Bright, position of 60. |
| 30. | 53, 54, 57, 58, 59, 61, 62, 63, 64. | E. about two days' distant, round very small spot (60). |
| 31. | 54, 57, 59, 61, 62, 63, 64, 65. | E. round 64, though far from limb. |

## APRIL 1893.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1. | 57, 59, 61, 62, 63, 64, 65. | W. long stretch f. group 61 S.E. |
| 2. | 57, 61, 62, 63, 64, 65. | W. bright and broad round 63. N. of 61. S.E. region of 66. |
| 3. | 57, 62, 63, 64, 65. | N.E. Numerous, with three very small spots. W. round 63. |
| 4. | 57, 62, 64, 65, 66. | E. Region of 66, extensive. N.W. |
| 5. | 57, 62, 65, 66, 67. | W. 10° to 25° N. |
| 6. | 62, 65, 66, 67, 68. | E. on a line with 66. |
| 7. | 62, 65, 66, 67, 68. | |
| 8. | 66, 67, 68, 69. | E. wide spread, f. 67. |
| 9. | 66, 67, 68, 69, 70. | E. f. 67, and to the S. of it. W., N., S. of the equator. |
| 10. | 66, 67, 68, 69, 70, 71. | S.E., on a line with 67. W. 10° N. |
| 11. | | |
| 12. | 67, 68, 69, 70, 72, 73. | |
| 13. | 67, 69, 70, 71, 72, 73, 74, 75. | E., on a line with 73. W., S. of 67. |
| 14. | 67, 69, 70, 72, 73, 74, 75. | W., S. of 69. |
| 15. | 67, 70, 72, 73, 74, 76. | E., f. 74. W., S. of 70. |
| 16. | 67, 70, 72, 73, 74, 76, 77. | |
| 17. | | |
| 18. | 67, 73, 74, 76, 77, 78. | |
| 19. | 73, 74, 76, 77, 78, 79. | |
| 20. | 73, 74, 76, 77, 78, 79, 80, 81. | E. Many p. and S. of 81. |
| 21. | 73, 74, 76, 77, 78, 79, 80, 81. | E. Region of 81 and 20° to 33° S. |
| 22. | 73, 74, 77, 78, 79, 80, 81, 82, 83. | E. Bright round and p. 83. Numerous near 83. |
| 23. | 73, 74, 77, 78, 79, 80, 81, 82, 83, 84. | |
| 24. | 74, 77, 78, 79, 80, 81, 82, 83, 84, 85. | |
| 25. | 77, 78, 79, 80, 81, 82, 83, 84, 85. | E., small but bright, about 5° N. |
| 26. | 77, 80, 81, 83, 84, 85. | E. Same position. W. bright between 78 and 80. |
| 27. | 78, 81, 83, 84, 85, 87. | |
| 28. | 78, 81, 83, 84, 85, 86, 87, 88, 89, 90. | E. bright, N. of 90. Position of 91. |
| 29. | 78, 81, 83, 84, 85, 86, 87, 88, 89, 90, 91. | |
| 30. | 81, 83, 84, 85, 86, 87, 89, 90, 91, 92. | |



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## MAY 1893.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1. | 81, 83, 85, 86, 90, 91, 92. | |
| 2. | | |
| 3. | 81, 85, 86, 90, 91, 92, 93, 94, 95, 96. | E. limb between 94 and 96. W., S. of 85 and 83. |
| 4. | 85, 86, 90, 91, 92, 93, 94, 95, 96, 97. | Observed to the centre of disc. W. bright. |
| 5. | 85, 90, 91, 92, 93, 94, 95, 96, 97. | |
| 6. | 85, 90, 91, 92, 94, 95, 96, 97. | |
| 7. | 90, 91, 92, 94, 95, 96, 97, 98. | E. To the S. of group 98. |
| 8. | 90, 91, 92, 94, 95, 96, 97, 98, 99. | E. f. 90 and a patch more N. |
| 9. | 91, 93, 94, 95, 96, 97, 98, 99. | E. Between 98 and 99. |
| 10. | 91, 92, 94, 95, 96, 98, 99. | |
| 11. | 91, 94, 95, 96, 98, 99, 100, 101, 102. | N.E. Stretching far from limb. W., S. of 91. A patch more N. |
| 12. | 94, 95, 98, 99, 100, 101, 102. | W. Round 101. |
| 13. | 94, 95, 98, 99, 100, 101, 102. | W. Region of 101. |
| 14. | 94, 98, 99, 100. | |
| 15. | | |
| 16. | 98, 99, 100. | |
| 17. | 98, 99, 100. | |
| 18. | 98, 99, 100. | |
| 19. | 98, 100, 103, 104, 105. | S.E. limb extensive. Two very small spots on the equator not numbered. |
| 20. | 100, 103, 104, 105, 106. | S.E. round 106, more N. W. p. 100, region of 103. |
| 21. | 100, 103, 105, 106, 107. | |
| 22. | 100, 106, 107, 108, 109. | E. Extensive to the S. of 107. |
| 23. | 106, 107, 108, 109, 110. | |
| 24. | 106, 107, 108, 109, 110. | |
| 25. | 106, 107, 108, 109, 110, 111, 112, 113. | N.E. Broad and bright. W. Patch far from limb on a line with 108. |
| 26. | 106, 107, 108, 109, 111, 112, 113, 114. | N.E. Same position as on the 25th. |
| 27. | 106, 107, 108, 109, 111, 112, 113, 114. | N.E. Still visible further from limb. S.E. p. 114. |
| 28. | 106, 107, 108, 109, 111, 112, 113, 114, 115, 116. | W. p. 111. Two small spots not numbered 2° S. lat. Long. 125°. |
| 29. | 106, 108, 109, 111, 112, 114, 115, 116. | |
| 30. | 106, 109, 114, 115, 116, 117. | |
| 31. | 106, 109, 114, 115, 116, 117. | |

## JUNE 1893.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1. | 109, 114, 115, 116, 117. | S.W. very extensive far to the S. |
| 2. | 114, 115, 116, 117, 119. | E. 10° to 15° S. lat. |
| 3. | 114, 115, 116, 117, 118, 119. | Still conspicuous near S.W. limb. |
| 4. | 114, 115, 116, 117, 118, 119, 120. | W. 16° N. lat. |
| 5. | 114, 115, 117, 118, 119, 120, 122. | W. Conspicuous on a line with group 118. |
| 6. | 114, 115, 117, 118, 119, 120, 121, 122. | |
| 7. | 115, 117, 118, 119, 120, 121, 122, 123, 124. | N.W. limb. |
| 8. | 115, 117, 118, 119, 120, 121, 122, 123, 124. | W. 12° to 20° N. |
| 9. | 115, 117, 118, 119, 120, 121, 122, 123, 124. | |
| 10. | 117, 119, 120, 121, 122, 123, 124, 125. | E. 10° to 20° S. faint. |
| 11. | 119, 120, 121, 122, 123, 124, 125, 126. | S.E. (same position) where group 127 appeared on the 13th. |
| 12. | 119, 121, 122, 124, 125, 126. | |
| 13. | 119, 121, 122, 124, 125, 126, 127. | |
| 14. | 121, 122, 124, 125, 126, 127, 128, 129, 130. | Preceding group 123. |
| 15. | 121, 122, 124, 125, 126, 127, 128, 129, 130. | P. 121. F. 129 to E. limb, branching, numerous. |
| 16. | 121, 122, 124, 125, 126, 127, 128, 129, 130. | Same position E., long stretch. |
| 17. | 121, 122, 124, 125, 126, 127, 128, 129, 130. | N.E. On a line with 129 and S.E. f. 130. |
| 18. | 124, 126, 127, 128, 129, 130, 131, 132. | S.E. enormous extent, and N.E. |
| 19. | 126, 127, 128, 129, 131 132. | Still S.E. and N.E. (No groups followed). |
| 20. | 127, 128, 131, 132, 132*. | N.W., large. S.W. close to limb, position of 127. |
| 21. | 131, 132. | Four very small spots near W. limb, with many faculæ, not numbered. Small patch S.W. Position of 133. |
| 22. | 131, 132, 133. | |
| 23. | 131, 132, 133, 134, 135, 136, 137. | S.E., following 137. |
| 24. | 131, 132, 133, 134, 135, 136, 137, 138. | Very bright patch E. |
| 25. | 131, 132, 133, 135, 136, 137, 138, 139, 140. | |
| 26. | 133, 135, 136, 138, 139, 140. | N.W. wide spread. |
| 27. | 135, 136, 138, 138*, 139, 140, 141. | Following 139, long, sweeping. A patch some distance in advance of 141. |
| 28. | 135, 136, 138, 138*, 139, 140, 141. | N.W. of group 135. A pair of spots s.f. not numbered. E. patch still visible. |
| 29. | 135, 136, 138, 138*, 139, 141, 142, 143. | NE. following 141, very numerous. |
| 30. | 135, 136, 138, 138*, 139, 140, 141, 142, 143. | S.E. round 136, and stretching N. of it; very bright. |



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## JULY 1893.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1. | 135, 136, 139, 141, 143. | N.E. near limb. W. In round patches N. of 136. |
| 2. | 139, 141, 143, 144. | N. E. extensive. S.W. p. 142. |
| 3. | 139, 141, 143, 144. | N.E. extending far from limb. One patch conspicuous. |
| 4. | 141, 143, 144. | N.E. The patch still visible. N.W. |
| 5. | 143, 144. | N.E. numerous; a few very small spots, and also where the patch was seen. |
| 6. | 143, 144, 145, 146. | 7° S.E., 7° to 55° E. Also 10° to 20° N.E. |
| 7. | 143, 144, 145, 146, 147, 148, 149. | N.E. f. 149. N.W. and S.W. |
| 8. | 143, 144, 146, 147, 148, 149, 150, 151, 152. | W. very extensive 12° to 33° N. region of 141. |
| 9. | 143, 144, 146, 148, 149, 150, 151, 152. | N.W., same position, p. 150. |
| 10. | 143, 144, 146, 148, 149, 151, 152, 153. | E. 5° to 25° N.; 15° to 30° S.; W. 20° to 25° N. |
| 11. | 143, 144, 146, 148, 149, 151, 152, 153, 154. | E. 0° to 25° N.; 14° to 30° S. |
| 12. | 144, 146, 148, 149, 151, 152, 153, 154, 155. | |
| 13. | 144, 146, 148, 149, 151, 152, 153, 154, 155. | |
| 14. | 144, 146, 148, 149, 151, 152, 153, 154, 155. | E. 10° N., and also much more N. |
| 15. | 146, 148, 149, 152, 153, 154. | |
| 16. | 146, 149, 152, 153, 154. | W. Many round 146, and 15° to 22° S. |
| 17. | 146, 149, 152, 153, 154. | E. 16° to 30° N.; 9° to 35° S. bright. W. 15° to 35° N. |
| 18. | 146, 149, 152, 153, 154, 156. | E. 30° S.; also W.N. of 146. |
| 19. | 149, 153, 154, 156, 157, 158, 159. | W., position of 152. |
| 20. | 149, 153, 154, 156, 157, 158, 159, 160. | |
| 21. | 153, 154, 157, 158, 159, 160, 161. | A great amount round 160. |
| 22. | 154, 157, 158, 159, 160, 161. | E. 7° to 30° S. region of 160. Three patches S. of 161 at 9h. 30m. a.m. |
| 23. | 154, 157, 158, 159, 160, 161. | |
| 24. | 157, 158, 159, 160, 161. | W. |
| 25. | 157, 158, 159, 160, 161. | W. round 158. A small spot about 20° p. 157. |
| 26. | 157, 160, 161, 162. | E. 18° to 38° N., region of 162. 10° to 20° S. W. 10° to 20° S.; far from limb. |
| 27. | 157, 160, 161, 162. | E. 25° to 33° N. and S. f. 162. |
| 28. | 157, 160, 161, 162, 163. | E. 5° to 35° N.; 8° to 30° S. W.; 15° to 25° N.; 10° to 40° S. |
| 29. | 157, 160, 161, 162, 163, 164, 165. | N.E. Some at a distance from limb; S. p. 165. W. S. of 157 and f. |
| 30. | 157, 160, 162, 162*, 163, 164, 165, 167, 168. | E. Small patch N. of region where 169 appeared. W. 20° to 30° N.; 10° to 40° S., 6 small spots. S. about 2 days W. of centre. |
| 31. | 162, 162*, 163, 164, 165, 166, 167, 168. | E. round a tiny spot, not numbered. Region of 165 and 169. W. numerous to the N., not near limb. |

## AUGUST 1893.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1. | 161, 162, 162*, 163, 164, 165, 166, 168. | E. limb. 7° to 21° N.; W. 20° to 30° N. Region of 161. |
| 2. | 162*, 165, 166, 168, 169, 170. | W. limb 20° to 35° N.; 15° to 40° S. |
| 3. | 162*, 165, 166, 168, 169, 170, 171. | E. of group 170. W. many near and N. of 162*. |
| 4. | 162*, 165, 166, 168, 169, 170, 171. | Very numerous f. and N. of 162* in small patches. |
| 5. | 165, 166, 168, 169, 170, 171, 172, 173. | E. near equator f. 167. W. far N. |
| 6. | 165, 166, 168, 169, 170, 171, 172, 173, 174. | W. 20° to 30° N. |
| 7. | 165, 166, 168, 169, 170, 171, 172, 173, 174, 175, 176. | E. numerous, and W., especially N.W. |
| 8. | 165, 166, 168, 169, 170, 171, 172, 173, 174, 175, 176. | E. N. of 175; W. N. of 165. One small spot. |
| 9. | 165, 166, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177. | Many near E. and W. limbs. |
| 10. | 165, 166, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177. | E. a patch 5° S. and 24° S. Tiny spot Long. 280°. Lat. 48° N. |
| 11. | 166, 169, 170, 171, 172, 173, 175, 176, 177, 178. | |
| 12. | 166, 169, 170, 171, 172, 173, 175, 176, 177, 178, 179. | E., N., f. 179, S.E. |
| 13. | 169, 170, 172, 173, 175, 176, 177, 178, 179, 180. | N.W. conspicuous, and S. of 167. |
| 14. | 172, 173, 175, 176, 177, 178, 179, 180, 181. | W. S. of 178. N.W. position of 170. |
| 15. | 172, 173, 175, 176, 177, 178, 179, 180, 181. | E. Many near 181 and S. of it. W. N., f. 178; one at some distance. |
| 16. | 173, 175, 176, 179, 180, 181, [182, 183. | W. streaming from 175 to limb. Region of 173. |
| 17. | 175, 176, 179, 181, 182, 183, 184, 195. | E. very near limb. N. of 185. W. region of 175 and f. at some distance. |
| 18. | 176, 179, 180, 181, 182, 183, 184, 185, 186. | E. extensive, N. of 185. W. N. of 176, bright, round. |
| 19. | 176, 179, 181, 182, 183, 184, 185, 186, 187, 188. | E. N. of 185. W., many; region of 176. |
| 20. | 179, 181, 182, 183, 184, 185, 186, 187, 188, 189. | E. f. 188. W. position of 179. |
| 21. | 179, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191. | E. N. of 188, bright, with two small spots, 15° N. |
| 22. | 179, 181, 182, 183, 184, 186, 188, 189, 190, 191. | E., N. of 191. W. near limb. |
| 23. | 181, 182, 183, 184, 186, 188, 189, 190, 191, 192. | N.W., same position as on 22nd. Patches p. 186. |
| 24. | 181, 182, 183, 184, 186, 188, 189, 190, 191, 192. | E. S. f. 192, and a little S. of equator. |
| 25. | 181, 182, 183, 184, 186, 188, 189, 190, 191, 192, 192*. | E. region of large spot 17° S. Two little pairs. Long. 284°, Lat. 17° S. |
| 26. | 182, 183, 184, 186, 188, 189, 191, 192, 192*. | Very extensive, same region. |
| 27. | | |
| 28. | 184, 189, 191, 192, 192*, 193, 194, 195. | S.E. numerous and remarkable, p. 194 and 195. |
| 29. | 189, 191, 192, 192*, 193, 194, 195. | W. near equator, N. of 184. |
| 30. | 189, 192, 192*, 193, 194, 195. | W. S. of position of 184. |
| 31. | 192, 193, 194, 195, 196. | E. Long stretch, tapering off, f. 195. |



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## SEPTEMBER 1893.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1. | 192, 193, 194, 195, 196. | |
| 2. | 192, 193, 194, 195, 196. | |
| 3. | 192, 193, 194, 195, 196. | N.E. limb f. a small spot not numbered. S.W. p. a small spot, not numbered. |
| 4. | 193, 194, 195, 196, 197, 198. | N.W. position of 192; extensive S.W. 10° to 20°. |
| 5. | 193, 194, 195, 196, 198. | N.E. 10° to 20° (two small equatorial spots). |
| 6. | 193, 194, 195, 196, 198, 199, 200. | |
| 7. | 193, 194, 195, 196, 198, 199, 200. | E. limb 8° to 15° N.; W. limb 5° to 20° N. |
| 8. | 194, 195, 196, 198, 199, 201, 202. | E. 10° to 25° N. |
| 9. | 194, 195, 198, 201, 202. | E. 15° to 30° N.; W. f. groups 193 and 195. |
| 10. | 198, 201, 202, 203. | E. 5° to 20° N. |
| 11. | 198, 201, 202, 203, 204. | |
| 12. | 198, 201, 202, 203, 204, 205. | E. round patch N., p. 204, some distance from limb, not seen in P.M., W. 3° to 30° S. |
| 13. | 198, 201, 203, 204, 205, 206, 207. | |
| 14. | 198, 201, 203, 204, 205, 206, 207. | E. 6° to 40° S.; W. 10° to 23° N.; 0° to 30° S. One patch bright. |
| 15. | 201, 203, 204, 205, 208, 209, 210. | E. 0° to 20° N.; a broad patch N. of 209. |
| 16. | 201, 203, 204, 209. | N.E., not near limb. |
| 17. | 201, 203, 204, 209, 210. | E., S. of group 210. |
| 18. | 201, 204, 209, 210. | |
| 19. | 204, 209, 210, 211. | E. Patches about 10° N. at some distance from limb. |
| 20. | 204, 209, 210, 211, 212. | |
| 21. | 209, 209*, 210, 212, 213, 214. | E., extensive, S. of 214. W. near equator. At 10h. 20m. one spot and 4 black dots. Long. 113°, Lat. 42° N. |
| 22. | 209, 209*, 210, 212, 213, 214, 215. | E. 5° to 28° S.; W. 5° to 35° S.; and round patches 10° to 15° S. |
| 23. | 209, 209*, 210, 212, 214, 215, 216, 217. | E. 7° to 30 S.; W. 5° to 30° S. |
| 24. | 209, 209*, 210, 214, 215, 216, 217, 218. | E. 10° to 30° S.; 5° to 20° N.; W. 30° to 40° S. |
| 25. | 209, 209*, 210, 214, 215, 216, 217, 218. | E. f. 218 as far S. as 30°; W. 18° to 36° S. |
| 26. | 209, 209*, 210, 215, 216, 217, 218. | |
| 27. | 209, 209*, 210, 215, 217, 218, 219. | E. many, one small patch bright; W. a patch far S., not near limb. |
| 28. | 217, 218, 219. | |
| 29. | 217, 218, 219, 221. | |
| 30. | 217, 218, 219, 220, 221. | |

## OCTOBER 1893.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1. | 217, 218, 219, 220, 221, 222. | |
| 2. | 217, 218, 219, 220, 221, 222. | E. limb, N. and of the equator. |
| 3. | 217, 218, 219, 220, 220*, 221, 223. | E. 0° to 15° N.; 20° to 30° S. W. 0° to 18° S.; 25° to 45° S. |
| 4. | 217, 218, 219, 220*, 221, 223. | E. 0° to 35° S.; W. 0° to 22° S.; 0° to 25° N. |
| 5. | 217, 218, 219, 220*, 221, 223, 224. | E. 15° to 27° N.; 0° to 25° S. W. 5° to 25° N.; 5° to 18° S. |
| 6. | 217, 220*, 221, 223, 224, 225. | E. 10° to 30° N.; 10° to 23° S. W. 5° to 30° S.; p. group 225. |
| 7. | 220*, 221, 223, 224, 225, 226. | E. 18° to 28° N.; 10° to 25° S. W. 13° to 23° N.; 8° to 35° S. |
| 8. | 220*, 221, 223, 224, 225, 226. | E. 5° to 25° S. W. 7° to 17° S.; 28° to 40° S. |
| 9. | 220*, 221, 223, 224, 225, 226. | E. 0° to 30° S. W. 5° to 35° S.; 0° to 7° N. |
| 10. | 221, 223, 225, 226, 228. | E. 8° to 33° S. W. 0° to 30° S.; 0° to 16° N. |
| 11. | 223, 225, 226, 228. | |
| 12. | 223, 225, 226, 227, 228, 229. | E. 0° to 30° N. W. 10° to 30° S., very extensive. A patch N.W., far from limb. |
| 13. | 225, 226, 227, 228, 229. | E. 3° to 18° N. W. 10° to 30° S. |
| 14. | 225, 226, 227, 228, 229, 230, 231. | |
| 15. | 225, 227, 228, 229, 230, 231. | |
| 16 | 227, 228, 229, 230, 231. | E. 7° to 20° N. W. 8° to 25° S. |
| 17. | 227, 228, 229, 230, 231. | |
| 18. | 227, 228, 229, 230, 231, 232, 233. | E. 0° to 35° N.; 5° to 25° S. W. 5° to 40° S. Position of spots on the 19th. |
| 19. | 227, 228, 229, 230, 231, 232, 233, 234. | E. 0° to 15° N.; 5° to 30° S. W. 10° to 25° S. |
| 20. | 227, 228, 229, 230, 231, 232, 233, 234. | S.W., still numerous. |
| 21. | 227, 228, 229, 230, 231, 232, 233, 234, 235. | E. 5° to 20° N.; 10° to 25° S. W. 15° to 35° N.; 10° to 35° S. |
| 22. | | |
| 23. | 229, 230, 231, 232, 233, 234, 235, 236, 237, 239. | E. 5° to 25° N.; 5° to 15° S. |
| 24. | 229, 231, 232, 233, 234, 235, 236, 237, 238, 239. | E. 10° to 20° N. |
| 25. | 229, 231, 233, 234, 235, 236, 237, 238 240. | |
| 26. | 232, 233, 234, 235, 236, 237, 238, 240. | E. 0° to 25° N.; 0° to 5° S. W. 10° to 25° S. |
| 27. | 232, 233, 234, 235, 237, 238, 240. | E. 0° to 25° N.; 0° to 15° S. W. 8° to 25° N. |
| 28. | 232, 233, 234, 235, 237, 238, 240. | |
| 29. | 232, 234, 235, 237, 238, 240. | W. 0° to 25° N. 6° to 30° S. |
| 30. | 233, 234, 235, 237, 238, 241. | W. 0° to 28° N.; 0° to 30° S. Bright close to 234. |
| 31. | 233, 235, 237, 241. | E. 5° to 15° S. W 0° to 15° N.; 0° to 20° S. |



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## NOVEMBER 1893.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1. | 235, 237, 241, 242. | E. limb. Bright patch S. of group 241. |
| 2. | 235, 237, 241, 243. | |
| 3. | 237, 241, 242*, 243. | E. far S. W. region of 235. |
| 4. | 237, 241, 242*, 243. | E. 20° S.; 30° N. (A tiny jet black spot, Long. 155°, Lat. 18° N.) |
| 5. | 241, 242*, 243. | E., very numerous, 20° S. W. far N. |
| 6. | 241, 242*, 243, 244. | E. many far S. W. numerous from equator to far N. |
| 7. | 241, 242*, 243, 244, 245. | E. a bright patch about 20° S. |
| 8. | 241, 242*, 243, 244, 245, 246, 247. | E. 15° to 20° S.; 14° N.; some distance from limb, and position of 249. |
| 9. | 242*, 244, 245, 246, 247, 248, 250. | |
| 10. | 242*, 244, 245, 246, 247, 248, 250, 251. | |
| 11. | 242*, 244, 246, 247, 248, 249, 250, 251, 252, 253, 254. | |
| 12. | 242*, 244, 246, 247, 249, 250, 251, 252, 253, 254, 255. | |
| 13. | 242*, 244, 246, 247, 249, 250, 251, 252, 252*, 253, 254, 255. | W., great amount round 243. |
| 14. | | |
| 15. | 246, 247, 250, 251, 252, 252*, 253, 254, 255, 256. | E. far to the S. |
| 16. | | |
| 17. | | |
| 18. | | |
| 19. | 251, 255, 256, 257, 258, 259. | |
| 20. | 251, 255, 256, 257, 258, 259. | |
| 21. | 255, 256, 257, 258, 259. | Considerable near W. limb. |
| 22. | 255, 256, 257, 258, 259. | W. 5° to 21° N.; 16° to 24° S. |
| 23. | 255, 256, 257, 258, 259, 260. | E. 15° to 23° N. W. 15° to 25° N.; 7° to 14° S. |
| 24. | 255, 256, 257, 258, 259, 260. | |
| 25. | 256, 257, 258, 259, 260, 261. | E. f. 261. W. 0° to 18° N.; 0° to 22° S. |
| 26. | 257, 258, 259, 260, 261. | |
| 27. | 258, 259, 260, 261. | E. 0° to 15° S. Many round 259 and S. of 258. |
| 28. | 259, 261, 262. | |
| 29. | 261, 262, 263. | |
| 30. | | |

## DECEMBER 1893.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1. | 261, 262, 263. | E. limb 15° to 25° N. |
| 2. | 261, 262, 263. | S.E., same position, but nearer limb. N. f. 263. |
| 3. | 261, 262, 263, 264. | E. 10° to 17° S.; W. p. 262. |
| 4. | 261, 263, 264, 265. | |
| 5. | | |
| 6. | 263, 264, 265. | E. 10° to 22° N.; 3° to 15° S. Two conspicuous black dots, s. f. |
| 7. | 263, 264. | E., small bright patch 20° N.; position of 266; many small, 5° to 15° S. |
| 8. | 263. | |
| 9. | 263. | N.E. and S.E.; many small S.; W. in two places. |
| 10. | 263, 265*. | N.E. faint. A small black spot, f. 265* at 3 p.m. |
| 11. | 263, 265*. | E. f. group 265. Three little spots near W. limb in S. lat. Sprung from the faculæ of 9th and 10th. |
| 12. | 265*, 266. | |
| 13. | 265*, 266, 267, 268. | |
| 14. | 265*, 266, 267, 268, 269. | |
| 15. | 265*, 266, 267, 268, 269. | E. 8° to 20° N.; W. 15° to 22° S. |
| 16. | 265*, 266, 267, 268, 269. | |
| 17. | 265*, 266, 267, 268, 269. | |
| 18. | 265*, 266, 267, 268, 269, 270, 271. | |
| 19. | 265*, 266, 267, 268, 269, 270, 271. | E. 5° to 15° N.; W. 17° to 25° S. |
| 20. | 265*, 266, 267, 268, 269, 270, 271, 272, 273, 274. | E. 10° to 25° N.; W. 15° to 22° S. |
| 21. | 266, 267, 268, 269, 270, 271, 272, 273, 274, 275. | E. 10° to 20° N.; 3° to 9° N., and 18° to 35° S. |
| 22. | 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276. | |
| 23. | 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278. | E. 15° to 30° N.; 8° to 20° S. W. 0° to 30° N.; 0° to 16° S. |
| 24. | | |
| 25. | 267, 268, 269, 270, 272, 273, 274, 275, 276, 277, 278, 279. | E. 5° to 20° N.; W. 7° to 20° N.; 5° to 17° S. |
| 26. | 270, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281. | |
| 27. | 270, 272, 273, 274, 275, 276, 278, 279, 280, 281. | E. 3° to 15° S.; 12° to 25° N. |
| 28. | 270, 272, 273, 274, 275, 276, 278, 279, 280, 281. | |
| 29. | 270, 272, 273, 274, 275, 276, 278, 279, 280, 281. | E. 20° to 32° N.; 7° to 17° S. W. 5° to 23° N. |
| 30. | 270, 272, 273, 274, 275, 276, 278, 279, 280, 281, 282, 283, 284 285. | E. 8° to 15° N.; W. 5° to 25° N. |
| 31. | 272, 273, 274, 275 276, 278, 279 280, 281, 28 284, 285. | W. 5° to 25° N.; 20° to 35° S. |



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# Sun-spot Report, 1893.

## LEDGER.

Jan. GROUP 1. *Long.* 7°. *Lat.* 14° S.

1. Two small spots, not far from W. limb. Another at some distance to the S.

Jan. GROUP 2. *Long.* 323° to 313°. *Lat.* 24° S.

1. A large spot with the nucleus cloven in front and tapering at the end. The small f. spots seen in December much decreased (group 222), with the exception of one nearly circular. A few outliers to the E.
2. Large spot rather smaller, nucleus triangular, the f. spot little changed, outliers altered in position and possibly not the same.
4. Nearing W. limb, bright on the p. side of the nucleus as if faculæ were covering the penumbra, rather resembling the phenomenon described by Mr. Adams on December 26, 1892. (*See* "British Astronomical Association Journal," Vol. III., p. 143.)

Jan. GROUP 3. *Long.* 278°. *Lat.* 7° to 12° N.

1. A new group to the E. of the centre of disk. The p. spot with penumbra and four small nuclei, a little cluster f. and a single spot to the N.
2. The p. more normal, only two f. and two to the N.
4. One penumbral spot, a stream of dots f.
6. Three small spots.

Jan. GROUP 4. *Long.* 276° to 270°. *Lat.* 13° S.

1. A very widely scattered group, spots all small, only three or four with slight penumbra. Those to the S. much increased since December.
2. Three small spots in a triangle, one rather larger f.
4. One very small spot, two dots f.

Jan. GROUP 4*. *Long* . *Lat.* .

6. Two small spots N., p. more than half of sun's radius from centre.
8. Rather larger and more in number. Two to the S. of them.
9. Much larger.
10. Near W. limb, a compound spot, two preceding it.

Jan. GROUP 5. *Long.* 272° to 267°. *Lat.* 26° to 29° N.

1. A circular group of about 10 little spots.
2. Four, forming a trapezium, the three most p. double.
4. More small spots 3° to the N. of the trapezium, in two streams.
6. Two sets of small spots.
8. Near W. limb, very small.

Jan. GROUP 6. *Long.* 264° to 258°. *Lat.* 17° S.

1. A group in three divisions, spots all small.
   (On this date groups 4, 5, and 6 formed a large irregular pentagon.)
2. Spots altered in position, rather smaller but more numerous.
4. One spot only.

Jan. GROUP 7. *Long.* 207°. *Lat.* 23° N.

2. A spot not far from E. limb.
4. Larger, penumbra chiefly on the f. side. Three dots f.
6. Decreasing.
8. Very small.



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Jan. GROUP 8. *Long.* 200° to 190°. *Lat.* 16° N.
2. A small spot near E. limb.
4. Two spots 10° apart, penumbra on the f. side.
6. Each with an outlier, the p. smaller.
8. Outliers more numerous.
9. Two pairs.
10. The f. single, both without penumbra, some dots between.
11. Two tiny spots.

Jan. GROUP 9. *Long.* 254° to 251°. *Lat.* 30° S.
2. A few very small spots.
4. A tiny cluster, chiefly composed of dots.

Jan. GROUP 10. *Long.* 250° to 247°. *Lat.* 8° S.
4. A spot with slight penumbra, near the centre of disk, three smaller f.
6. Two or three little spots.

Jan. GROUP 11. *Long.* 99°. *Lat.* 8° to 9° S.
9. A large spot close to E. limb. (A return of group 221. Latitude more S.)
10. Nucleus divided.
11. Three nuclei, an opening in the penumbra to the N. Three outlying spots to the S.
13. A compound spot with six nuclei, apparently breaking up.
14. Three principal nuclei forming a triangle.
15. Two small irregular spots with slight penumbra; a third without any to the N. Outliers more distant, mere dots.
17. Five spots.
18. A few very small spots.

Jan. GROUP 12. *Long.* 98°. *Lat.* 14° N.
10. A small spot not far from E. limb.
11. Much reduced.

Jan. GROUP 13. *Long.* 91°. *Lat.* 10° N.
10. A penumbral spot near E. limb.
11. Normal.
13. Nucleus more angular, a small spot p.
14. Little change.
15. Circular. Showing signs of central disruption.
17. Little change.
18. The p. spot not seen.

Jan. GROUP 14. *Long.* 20° to 9°. *Lat.* 9° to 14° S.
15. A pair of very small spots in the midst of faculæ.
17. Six or eight spots, two of them considerable, confluent.
18. No details.
20. A beautiful cluster, composed of an immense number of small nuclei linked together with penumbra, and accompanied by many outlying spots and dots.
21. Many minor changes, whole group half-moon shaped; a little stream p.; a central spot more normal than the rest, with nuclei in a ring; penumbra more diffused. The f. portion forming a curious zigzag of nuclei and penumbra alternating with each other at right angles.
22. Still very intricate, but individual spots more separate; a ladder-like chain of very small ones to the N. of the zigzag, which is much reduced, having lost its distinctive character. To the S.W. six fresh spots in an ellipse, giving the cluster a more circular outline.
23. A leading spot, with divided nucleus, nearly circular, just severed from the rest, which are still undergoing changes and becoming more attenuated. More outliers N. f.



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Jan. GROUP 14—*continued.*

24. Cluster in two divisions, decreasing.
25. One considerable spot only.
26. Two spots N. and S. of each other, outliers few.
27. Near W. limb, the largest spot with three nuclei; a few following at some distance, and a new penumbral one in Lat. 18° S.

Jan. GROUP 15. *Long.* 6° to 356°. *Lat.* 8° to 10° S.

20. Two penumbral spots, 8° apart, in a line with group 14, the most p. with barred nuclei and inclined to the equator, the f. with a double nucleus, more vertical.
21. Both spots with nuclei tapering at one extremity, the f. one to the S. instead of to the N., as on the 20th. Two little spots between them.
22. The p. rounder and smaller, the f. nearly vertical, nucleus bridged over.
23. The p. still more reduced; the f. with three nuclei, in length 40″ near the central meridian, and equatorial instead of vertical.
24. No details.
25. Only one spot.
26. A pair.
27. Three very small spots.

Jan. GROUP 16. *Long.* 344° to 335°. *Lat.* 15° N.

21. Hazy little spots in two sets.
22. An irregular stream consisting of three small spots close together in a triangle, four more f., and lastly a compound spot with slight penumbra.
23. The p. spots all increased; the stream now zigzag, in four divisions.
24. Two spots only conspicuous.
25. A double spot p. followed by a train of lesser ones.
26. P. normal, some of the lesser combined and forming an elongated spot.
27. P. with angular nucleus, dots only f.
28. No details.
29. One very small spot with a great extent of faculæ.

Jan. GROUP 17. *Long.* 34° to 30°. *Lat.* 25° S.

21. Four small spots some distance apart, the two f. pairs.
22. Three spots.
23. Two, nearer each other.
24. Little change.
25. Nearing W. limb.

Jan. GROUP 18. *Long.* 275° to 265°. *Lat.* 18° to 22° S.

23. A small spot near E. limb.
24. Several.
25. A train, spots mixed with penumbra.
26. One spot very large, nucleus hooked, three more with penumbra and outliers.
27. Two striking spots. The p. with two nuclei, lying side by side, the space between filled with faculous light; penumbra branching eastward with an isthmus to the N. joined to the main by a narrow arm, whole length, 1′45″. The f. with indented crescent-shaped nucleus and penumbra circling round. Scattered dots between the two. Two faint pairs f. at a distance.
28. P. with dense upper nucleus, lower dividing; faculous light still apparent. The penumbral isthmus severed, forming distinct spots; f. double, nuclei increased, confluent, in the form of an S. Faculous light close to them.
29. P. with streamers from the large upper nucleus, f. with penumbra on three sides; nucleus turned equatorially, altered and fimbriated.
30. Lower nucleus of p. diminishing; f. more normal.



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Jan. GROUP 18—*continued.*

31. P. with nuclei more lumpy. Outlying spots to the N. much decreased; f. with hooked nucleus, a stream of tiny spots issuing from it.

Feb.

1. Still a very striking group; p. with larger nucleus dividing, the smaller again united to it, branching penumbra to the N. much extended and attenuated, with small nuclei and two semi-circular curves at the base, changing rapidly in a few hours; f. with nuclei in a row, dots and sputterings above.
2. Only glimpsed.
4. Much broken up. Nuclei of p. fast decreasing; f. with penumbra to the N.
5. Near W. limb, group in four sections, the middle one apparently composed of penumbra only.
6. The most f. spot only visible at 11 a.m.

Jan. GROUP 19. *Long.* 310°. *Lat.* 6° S.

24. A penumbral spot N. f. group 18.

Jan. GROUP 20. *Long.* 320° to 312°. *Lat.* 15° to 18° S.

24. A new outburst, two spots at some distance from E. limb.
25. Three spots, the p. in advance of and larger than the others.
26. More, in a train, leader with double nucleus.
27. First and last spots nearly equal, with several nuclei, length about 30″. The rest all small, a few with slight penumbra.
28. First and last normal, small disappearing.
29. A stream rather than a train, first spot oval, tapering, last decreasing, penumbra on the f. side, intermediates fewer and smaller.
30. Decreasing.
31. A prolonged irregular stream of small spots.

Feb.

1. More numerous, in two groups, a great amount of penumbra.
2. The f. group only visible.

Jan. GROUP 21. *Long.* 285° to 279°. *Lat.* 19° N.

25. Two spots, about two days from E. limb.
26. The p. large normal, length 45″, with a projection containing a nucleus. Several penumbral followers.
27. P. little changed; f. two spots, each in the form of a half moon united at the cusps, a stream of little spots and dots intermediate, also sprinkled N. and S.
28. P. bridged, f. united. Two spots to the north much larger.
29. P. elongated, major axis 1′; f. semi-circular, penumbra to the E. One of the N. spots decreased, the other normal.
30. P. with cloven nucleus, pointed at the end; f. more normal. Outliers small.
31. P. with nucleus entire; f. much diminished.

Feb.

1. P. less oval, two penumbral spots f. One of these to the N. hardly visible.
2. No details.
4. One spot close to W. limb at 2.15 p.m.

Jan. GROUP 22. *Long.* 245°. *Lat.* 25° N.

26. A spot near E. limb.
27. Nucleus divided.
28. Normal.
29. Compound, major axis 40″. Much broken at the extremity.
30. Nearly circular.
31. No details.

Feb.

1. Smaller, penumbra on the p. side.
2. Very small.
4. Still decreasing.
5. Little change.
6. Nearing W. limb.



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Jan. GROUP 23. *Long.* 249°. *Lat.* 14° N.
26. A pair of spots near E. limb.
27. One only with penumbra, irregular, some outlying dots.
28. Normal.
29. Splitting in two, a nebulous spot p. at some distance.
30. More normal.
31. Decreasing.
Feb.
1. Nucleus double, p. spot gone. Two small outliers.
2. Three small spots.
4. Many more, surrounded with faculæ.
5. One to the N. penumbral, the rest nearly gone.
6. Near W. limb.

Jan. GROUP 24. *Long.* 255° to 252°. *Lat.* 12° to 14° S.
31. Two sets of tiny incipient spots, widely separated, recent outburst.
Feb.
1. Two indefinite spots, 5° apart.
2. No details.
4. One very small spot.

Feb. GROUP 25. *Long.* 213° to 211°. *Lat.* 25° S.
1. Four little spots following each other in a curved line.
2. The most p. increased.
4. Two sets of very small spots.
5. Three sets.
6. An irregular zigzag.
7. More in number, positions altered.
8. Fewer.

Feb. GROUP 26. *Long.* 225°. *Lat.* 22° S.
5. A new group, spots small and scattered.
6. Two spots.
7. The most f. with slight penumbra.
8. One spot.

Feb. GROUP 27. *Long.* 130°. *Lat.* 18° S.
5. Three small spots, in a triangle, some distance from E. limb.
6. Decreasing.
7. Two only.

Feb. GROUP 28. *Long.* 112° to 102°. *Lat.* 10° S.
5. A large group of small spots in a vertical line, near E. limb.
6. Nuclei all small, but penumbra increasing rapidly in two places.
7. Group in two divisions; the most p. very intricate, composed of many nuclei with interlacing penumbra; the f. more compact, leaf-shaped, curved and pointed at both extremities, with a double row of nuclei. Outliers between the two.
8. Both p. and f. divisions much concentrated and forming two regular spots. The f. with the nuclei larger and closer together, and a portion of the penumbra blunted at the extremity and almost severed. Outlying spots still numerous and increasing in area.
10. The p. spot nearly vertical, splitting in three; the f. very much lessened, with penumbra only on the f. side, intervening spots in three divisions.
11. Only glimpsed. A swarm of tiny spots following the group.
12. One large spot 1′ of arc in length. A mass of fragments f. with small nuclei and penumbra disposed in wreaths, a sweep of fresh "sputterings" bringing up the rear.
13. Main features unaltered.
14. The p. spot still larger, with two angular nuclei; the rest following in closer succession, and forming a serpentine train, penumbra rather in excess of the nuclei.



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Feb. GROUP 28—*continued.*

15. Spots separating, smaller nuclei fewer.
16. Much foreshortened, train in three parts, and gradually decreasing towards the f. end.
17. The p. very extensive, only one considerable spot f. (This train did not return.)

Feb. GROUP 29. *Long.* 187° to 183°. *Lat.* 14° N.

8. A fresh outburst. A small condensed cluster of nuclei, followed by a penumbral spot 20″ of arc in length.
9.
10. Little change, no outliers.

Feb. GROUP 30. *Long.* 72°. *Lat.* 17° S.

8. A penumbral spot near E. limb.
10. Little change, no outliers.
11. No details.
12. Nearly circular, nucleus double.
13. More oval, nucleus single and angular; two small followers.
14. Again nearly circular, nucleus two-lobed, no followers.
15. Nucleus quite severed. A small spot to the N. (not numbered) still visible.
16. Little change, one follower.
17. Nucleus deeply indented in the form of a horse-shoe.
18. No details.
19. Much foreshortened; nucleus divided.
20. Near W. limb.

Feb. GROUP 31. *Long.* 93° to 83°. *Lat.* 8° to 10° S.

10. A small nuclear spot not far from the centre of the disk.
12. Penumbra on the S. p. side, four small spots following at some distance.
13. Nucleus bridged over, penumbra all round.
14. Nucleus entire, f. spots decreasing.
15. Little change.
16. Two spots f.
17. Nearing W. limb, penumbra S. f.

Feb. GROUP 32. *Long.* 29° to 22°. *Lat.* 14° S.

11. A considerable spot close to E. limb.
12. A large group, leader wavy in outline, with nucleus and penumbra irregular, four nuclear spots f., besides stragglers.
13. Leader more normal.
14. Leader a striking compound spot, nucleus pointed, penumbra irregular, f. spots in a train, many of them pointed and wispy. A larger one to the N., semi-circular, with a little stream, chiefly dots, S. p.
15. Leader less angular, N. spot with dots spreading to the S.
16. Leader greatly altered, spreading out laterally, more than 1′ of arc in length, both nuclei and penumbra tripartite, last division with the nucleus again sub-divided; the f. train of the 14th more diffuse, individual spots less wispy with fresh ones sweeping round on the p. side, showing a large area of disturbance. The northerly spot with a triple nucleus and penumbra still to the S.
17. Leader with the third division entirely severed, outlying spots altered in position, but decreasing, those f. the leader in an elliptical group.
18. No details.
19. Leader hardly recognisable, in the form of a leaf, with a mid-rib composed of small beaded nuclei, the severed portion left behind as if a repulsive force had taken place.
20. Group decidedly altered and diminished, leader broken up into four fragments, two of them quite small, the larger ones not exceeding 15″ of arc in length. One still showing beaded nuclei.
23. Near W. limb.



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Feb. GROUP 33. *Long.* 125°. *Lat.* 11° N.

12. A small round nebulous spot of short duration.

Feb. GROUP 34. *Long.* 324°. *Lat.* 16° S.

16. A small nuclear spot near E. limb.
17. No increase.
18. No details.
19. Two small spots close together, penumbra very slight.
20. A pair.

Feb. GROUP 35. *Long.* 322°. *Lat.* 13° N.

18. Two little spots.
19. Slight penumbra.
20. One, without penumbra.
23. Very small.
24. Still smaller.

Feb. GROUP 36. *Long.* 304° to 287°. *Lat.* 16° N.

18. Several spots near E. limb.
19. A considerable group of irregular spots.
20. A train, spots much disjointed, the most p. with a horseshoe-shaped nucleus.
23. Widening at the extremity, five principal spots.
24. Outlying spots increasing, several of them normal. A double train.
25. Both trains, immensely expanded, lying N. and S. of each other, with two principal spots in each, a stream S. p. composed entirely of small ones, the most p. spot almost circular, with angular nucleus, the most f. made up of fragmentary nuclei, encompassed with penumbra. A multitude of small attendants widely scattered. A single spot N. f. at some distance.
26. Three principal spots, leader of the train to the N. with double nucleus, that of the train to the S. showing proper motion, having become vertical instead of equatorial. The most f. very complicated, an elongated nucleus having replaced the fragmentary ones. Fresh spots in the rear with sharp nuclei, small attendants on the wane, many of them also pointed.
28. Leader of N. train with three nuclei; all the followers gone. The S. spots much altered, forming a continuous train, expanding at the end. Individuals more distinct and equalised in area. The stream in advance very diminutive.

March.

1. Much foreshortened, northern leader little altered, train broken up by the disappearance of most of the intermediates. Nuclei small and more dispersed.
2. Leader vanished at 10.40. One large spot p. with much penumbra to the S. Two lesser ones f. Many scattered dots between them.

Feb. GROUP 37. *Long.* 270° to 262°. *Lat.* 15° to 19° S.

23. A little irregular stream.
24. One spot larger than the rest.
25. Largest spot, normal, surrounded by many very small ones.
26. Nucleus tripartite, outliers in a wavy stream before and behind.
28. Greatly reduced, penumbra on the f. side, outliers more dispersed. A small faint spot following at some distance.

March.

1. Penumbral spot no longer larger than the rest, which form a triangle. Distant spot increased.
2. Much altered, a large irregular spot leading, evidently a coalition A new one still further E.
4. Three spots widely separated; nearing W. limb.



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Feb. GROUP 38. *Long.* 218°. *Lat.* 20° S.
24. A penumbral spot near E. limb (return of a small group of scattered spots).
25 A smaller one following.
26. Nucleus curved equatorially. Two f. spots.
28. Much increased at 10.45 a.m.; length 1′ of arc, nucleus tapering, a few outliers, one of them penumbral. At 2.45 nucleus eel-shaped and bridged at the p. end.
March.
1. Singularly elongated, nucleus bridged in several places, very tapering. Some small outliers.
2. Split in two, arched. Nuclei of leader bridged in two places, of the f. small and beaded.
4. Leader more normal, f. in fragments, three faint spots f. at a distance.
7. More irregular, one f. spot.

Feb. GROUP 39. *Long.* 323°. *Lat.* 14° S.
28. Three very small spots not far from W. limb.

Feb. GROUP 40. *Long.* 267°. *Lat.* 20° N.
28. A small, nebulous, double spot.
March.
1. Little change.
2. A pair; two further off, widely separated, still more nebulous.

Feb. GROUP 41. *Long.* 188° to 175°. *Lat.* 2° to 6° N.
28. A few small spots not far from E. limb, one with slight penumbra.
March.
1. Two spots linked together by a curving stream of dots. A group of five scattered spots to the N.
2. The f. spot larger, crescent shaped. The N. group with one spot also larger than the rest.
4. The p. spot only with penumbra. The N. group more elliptical.
7. The p. spot much increased, elongated, 30″ of arc in length. None to the N.
8. Nearly normal. One faint spot has re-appeared to the N.
9. Decreasing.
10. Very small, near W. limb. This group was described in the "Journal," Vol. III., p. 273.

March. GROUP 42. *Long.* 159°. *Lat.* 18° S.
4. A few insignificant spots.
7. A feeble stream, inclined to a zigzag, the f. spot the largest.
8. More condensed.
9. The first and last spots only surviving.

March. GROUP 43. *Long.* 130°. *Lat.* 20° S.
4. Two penumbral spots and a small pair not far from E. limb.
7. A train of small spots, expanding at the end.
8. Two leading spots, the rest forming a zigzag.
9. Decreasing, the zigzag becoming elliptical.
10. Two little spots only, longitude more E.

March. GROUP 44. Long. 199° to 194°. Lat. 22° to 25° S.
8. A penumbral spot with double nucleus, a small pair to the S.
9. Nearing W. limb, two spots p., two smaller f.
13. A single spot.

March. GROUP 45. *Long.* 123°. *Lat.* 13° N.
8. A nebulous spot with one small follower.
9. Four very small spots, one of them a pair.
10. No increase.
11. A pair only.



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March. GROUP 46. *Long.* 93°. *Lat.* 11° N.
8. Two very insignificant spots at some distance from E. limb.
9. Four, N. and S. of each other, in a curve.
10. Five dots (a trio and a pair).

March. GROUP 47. *Long.* 41°. *Lat.* 8° S.
9. A large spot close to E. limb, a smaller one in advance in Lat. 14° S.
10. Many outliers, the S. spot with a double nucleus.
11. Nucleus hooked, four outlying spots with slight penumbra.
12. Normal, outliers increasing.
13. Nucleus dividing.
14. Spot normal, nearly 1′ of arc in diameter. Outliers very numerous. S. spot with penumbra S. p.
15. Little change except in some of the smaller outliers.
16. Outliers decreasing.
17. Outliers fewer, more dots.
18. Still normal, circular. Two outliers. S. spot decreasing, penumbra on the p. side.
19. Two small gaps in the penumbra. S. spot reduced to two dots.
20. A pair of dots only N. f.
21. Near W. limb, little change.
22. Close to W. limb at 9 a.m.

March. GROUP 48. *Long.* . *Lat.* 6° N.
10. A few scattered spots at some distance from W. limb. Surrounded with faculæ.

March. GROUP 49. *Long.* 108° to 104°. *Lat.* 10° S.
10. An irregular stream composed chiefly of dots.

March. GROUP 50. *Long.* 95°. *Lat.* 17° S.
14. A sickle-shaped group of very small spots. The leader with a double nucleus.
15. Three small spots.
16. Little change.
17. Nearing W. limb.

March. GROUP 51. *Long.* 356° *Lat.* 13° to 15° S.
17. Three dots.
18. Slight increase.
19. A swarm of dots, pretty widely separated.
20. Reduced to three.

March. GROUP 52. *Long.* 323°. *Lat.* 16° N.
17. A spot two or three days from E. limb, penumbra chiefly to the N.
18. Nucleus double. Penumbra still N.
19. A semicircle of small nuclei, some of them with penumbra.

March. GROUP 53. *Long.* 303° to 285°. *Lat.* 7° to 15° N.
17. A penumbral spot near E. limb, with a smaller one to the S. These were the forerunners of a long train, a return of the fine one previously observed (Group 36) in February and March.
18. Three spots with penumbra, three without; area of the spots much decreased since March.
19. Two spots, one normal, the other compound.
20. Four sets of spots, A. normal. B. an irregular pair. C. fragmentary. D. with two nuclei, tapering. Outliers few and widely dispersed.
21. A. with nucleus bridged over. B. a miniature group. C. a singular elongated spot with a sinuous stream of finely divided nuclei, a type represented in the large spot of Group 32. D. three-lobed, sprinkled with nuclei, and strikingly like the most f. spot of Group 36, on February 25.



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March. GROUP 53—*continued.*

22. A. elongated. B. diminishing. C. more normal. D. increasing and becoming a large spot. (A somewhat similar change took place in Group 36.)
23. A. quite detached from the rest of the train. B. in fragments. C. circular. D. compound, with dense central nucleus and branching beaded penumbra. The space between C. and D. filled with dots and penumbral patches.
24. Train hardly recognisable. A. breaking up. B. gone. C. with a tail-like appendage. D. two angular nuclei, and spiral penumbra. A fresh nuclear spot has appeared to the N.; and a little elliptical train follows. Between 9 a.m. and 4 p.m. further changes took place, a stream of dots instead of scattered spots leading the way. D. coalescing and showing filamentary streamers with the spiral penumbra dissevered. The little ellipse breaking up.
25. A. reduced to two small pairs. C. enlarging laterally, forming a compound spot with semi-detached masses of penumbra. D. almost circular, preceded by numerous dots, the nucleus in five portions, thus almost reverting to the type of the 21st, but with the gap to the rear instead of to the front.
26. A. a nebulous pair. C. more vertical and looped at the end. D. in two parts, with very small nuclei. The spot to the N. as well as the outliers fast decreasing.
27. A. still visible but more stream-like. C. normal, with a dense oblong nucleus, the loop of yesterday detached and composed chiefly of dots. D. very small, but nearly circular, a miniature double stream of dots p. it.
28. C. almost alone, penumbra opening on the S. f. side, outliers few and small, the double streams represented by three dots.
29. Little change.
30. Very near W. limb.

March. GROUP 54. *Long.* 276° to 273°. *Lat.* 23° N.

19. A large spot close to E. limb at 8 a.m.
20. Penumbra irregular, most extensive to the N.
21. Three nuclei, penumbra more to the f. than the p. side.
22. Two nuclei.
23. Nuclei large, curved, penumbra splitting mid-way.
24. Little change, major axis 1′ of arc (or 3°).
25. Nuclei more widely separated, leaving a central gap, penumbra hardly dissevered, but with two horns opposite the cleavage; a faint nebulous spot f.
26. Oblong, almost vertical, nuclei more contiguous, and penumbra entire; no outliers.
27. Little change.
28. Nuclei more angular.
29. Nucleus undivided but serpentine.
30. Little change. No perceptible difference in the width of penumbra on the p. and f. sides.
31. Near W. limb.

March. GROUP 55. *Long.* 312° to 305°. *Lat.* 15° S.

23. A pair of dots and a miniature stream. In nearly the same position as Group 20.
24. Dots become a nuclear crescent-shaped spot, followed by a pair with slight penumbra when observed at 9 a.m. Seven hours later the crescent had disappeared, leaving two pairs of somewhat nebulous spots more widely separated.
25. A great increase, the p. pair double, the f. a crescent-shaped spot with beaded nuclei, the horns in the opposite direction to the crescent of yesterday, a fresh spot between the two, all with a little penumbra.



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March. GROUP 55—*continued.*

26. Three well-defined spots, the most p. with three nuclei, the crescent form broken up but still traceable in the most f.
27. A train, the first and last spots the largest, penumbra predominating to the N.
28. Spots all much diminished, more dispersed, and without penumbra.
29. Near W. limb, in two sets.

March. GROUP 56. *Long.* 295° to 292°. *Lat.* 10° S.

23. Two tiny clusters not far from the centre of disk.
24. One small nebulous spot.

March. GROUP 57. *Long.* 216° to 213°. *Lat.* 20° S.

25. Two very small spots surrounded with faculæ.
26. One spot.
27. Three, widely separated.
28. An irregular cluster, spots all small.
29. Two little trains with pointed nuclei and slight penumbra, rapidly increasing in number, and forming later in the day an almost elliptical group, headed by a mass of closely packed nuclear spots with but little penumbra.
30. A pretty train, almost a zigzag, penumbra and nuclei intermingling and producing an appearance of lace or fret-work.
31. Individual spots more confluent, penumbra increasing, group inclined to an ellipse.

April.

1. Spots amalgamating, the leader more normal, with a double nucleus, those f. with spiral penumbra and strings of small nuclei showing great changes in a few hours, the nuclei enlarging and intertwining.
2. The p. spots rapidly diminishing and again more detached, the f. more branching but less spiral, with the nuclei more consolidated.
3. Nuclei again decreasing.
4. Much foreshortened, but evidently on the wane, the most f. spot the largest.
5. The f. spot only visible.

March. GROUP 58. *Long.* 206°. *Lat.* 16° N.

24. A spot close to E. limb at 4 p.m.
25. Nucleus double.
26. Penumbra more N.
27. Breaking up into small nuclei.
28. Elongated, nuclei in a row, penumbra diaphanous.
29. Much attenuated; a new spot to the N.
30. Two pairs of nebulous spots, widely separated.

March. GROUP 59. *Long.* 195°. *Lat.* 17° N.

25. A small spot near E. limb.
26. Penumbra slight, a small spot to the N.
27. Penumbra winged both N. and S. More outliers.
28. Nuclei tapering to the N. Penumbra only S.
29. Nuclei condensing, major axis less than 30″. Two outliers.
30. Nuclei again more divided. Outliers in a little stream p.
31. Oval, two nuclei, stream reduced to dots.

April.

1. Three small spots.

March. GROUP 60. *Long.* 197°. *Lat.* 30° S.

26. A pair and a trio of very small spots.
27. Two single spots.
28. No increase.
29. In the a.m. only bright faculæ At 4 p.m. a tiny elliptical group of small spots very near W. limb.

March. GROUP 61. *Long.* 226°. *Lat.* 25° N.

26. Two sets of little spots, 4° apart.
27. More dispersed.
28. Group elliptical; one spot with penumbra.
29. A pair; the rest almost gone.



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March. GROUP 61.—*continued.*
30. One larger spot; a stream of dots.
31. A single spot.
April.
1. A stream of small spots, the two most f. widely separated.
2. A single nebulous spot.

March. GROUP 62. *Long.* 181°. *Lat.* 15° S.
27. A compound spot near E. limb.
28. Nucleus cloven. An incipient stream S. f.
29. Little change.
30. Normal, tapering, major axis 30″.
31. F. stream more developed, curved.
April.
1. Increasing, nucleus double, length 45″, a small penumbral spot f.
2. Nucleus entire, but with two lobes, more f. spots, but all diminutive New ones have burst out at some distance S. f.
3. Normal. The nearest f. spots gone; the more distant increasing.
4. F. spots in a straggling train.
5. No change. Stragglers only three, one a pair.
6. Penumbra nearly equal. Two stragglers.
7. Near W. limb. Penumbra on the p. side.

March. GROUP 63. *Long.* 231°. *Lat.* 4° S.
27. Two faint spots near the centre of disk.
28. One small spot.
29. Not seen (hazy).
30. No increase.
31. A pair; a new spot some distance in advance.
April.
1. A little train.
2. A single small spot, faculæ surrounding.
3. Still smaller.

March. GROUP 64. *Long.* 148°. *Lat.* 13° N.
30. A pair of dots, close together, in the midst of faculæ.
31. Two spots, the f. with slight penumbra.
April.
1. A diminutive stream, a pair leading.
2. Three small spots.
3. One, very faint.
4. Two, one new.

March. GROUP 65. *Long.* 128°. *Lat.* 10° N.
31. A pair of very small spots not far from E. limb.
April.
1. The pair united and become a cloven spot with four nuclei; one f. in a large field of faculæ, and a miniature stream of dots.
2. Oval, two nuclei, length nearly 30″.
3. Breaking up, penumbra to the N. Eight hours later many dot-like nuclei, a few outliers.
4. Semi-circular, outliers smaller, altered in position.
5. Decreasing, penumbra still to the N.
6. A pair of very small spots without any penumbra, a faint one at some distance.
7. One very faint spot.

April. GROUP 66. *Long.* 84° *to* 81°. *Lat.* 19° S.
4. About four tiny spots, some hours later two more f.
5. A penumbral spot, with three nuclei, one or two f.
6. Normal, diameter 20″, many scattered dots f.
7. Oval, penumbra S. p. a nuclear spot f. dots more stream-like.
8. Smaller penumbra on the f. side, nuclear spot become a pair without penumbra, those f. in the form of a triangle.
9. All decreasing.
10. One little spot.



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April. GROUP 67. *Long.* 52° to 34°. *Lat.* 7° to 11° S.

5. A large spot near E. limb at 10.45 a.m.
6. Two spots and a few outliers, the p. compound, the f. more normal (a return of Group 47, but more S.)
7. P. tapering, almost normal. F. with several nuclei and numerous sputterings.
8. P. with a portion on the f. side severed. F. still the larger of the two nucleus angular, nearer outliers almost elliptical, with slight penumbra, the more distant very scattered and smaller.
9. P. normal, showing no sign of the severed portion, which has apparently re-united. F. also united to some of the outliers, the distant ones larger (secondary stream).
10. P. more equatorially inclined. F. enlarged, nucleus two-lobed, two patches severed on the f. side; secondary stream with about six spots.
12. P. little changed. F. more circular, diameter about 40″. One of the severed patches only left; secondary stream with fewer spots, two or three new ones still more distant to the S.
13. P. normal, circular. F. with a horse-shoe nucleus. Two pairs f. larger and altered in position.
14. Nucleus of p. splitting up, the f. in two halves, angular, the severed patch still visible, followers on the wane.
15. P. with penumbra more on the p. side; f. divided both as to nucleus and penumbra, a new pair N. f.
16. Both spots more alike, with divided nuclei.
18. The f. spot only visible at 8 a.m.

April. GROUP 68. *Long.* 82° to 78°. *Lat.* 9° S.

6. A very small spot surrounded by faculæ, three days from the centre of disk.
7. Two pairs, with very slight penumbra.
8. A zigzag; spots all small.
9. Spots in two sets, coalescing; the most f. much reduced.
10. Decreasing rapidly.
12. One very small hazy spot.

April. GROUP 69. *Long.* 78° to 72°. *Lat.* 2° to 3° N.

8. A little train of dots, equatorial. (*See* "Journal, Vol. III., p. 328.)
9. In two sets much larger and more extended. The spots well developed and confluent. The f. in a semicircle.
10. The p. a considerable spot, with four nuclei. A stream f. curved at the end.
12. A normal, nearly circular spot p. The f. reduced to three.
13. P. with two nuclei.
14. Decreased; one follower.

April. GROUP 70. *Long.* 58°. *Lat.* 28° S.

9. A group of small spots, leader with double nucleus and a little penumbra. At 6 p.m. resembling the wings of a bird.
10. At 8 a.m. immense increase. Leader with circular nucleus and penumbra to the S. Small spots f. in a double stream, the final one only with penumbra. At 6 p.m. further changes; stream no longer double, leader with cloud-like streamers connecting it with the f. spots, which are also more spiral.
12. Four distinct spots, the last new; another has also appeared to the E., distant the whole length of the train.
13. Train serpentine; spots smaller, excepting the first.
14. Decreasing, except the leader. The most distant one gone.
15. Leader with double nucleus. The f. few and small.
16. Penumbra on the p. side. One f. spot increased.



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April. GROUP 71. *Long.* 73°. *Lat.* 26° S.
10. A small nebulous spot not far from centre of disk.
12. Not seen.
13. Two very faint spots, widely separated.

April. GROUP 72. *Long.* 354°. *Lat.* 16° N.
12. A miniature train; slight penumbra.
13. A zigzag; no penumbra.
14. One nebulous spot; one outlier.
15. No increase.
16. Very faint and small.

April. GROUP 73. *Long.* 332°. *Lat.* 14° S.
12. A large spot about one day from E. limb, with penumbra sweeping to the S., and a few outliers. A smaller spot f. Faculæ were observed in this region on the 10th.
13. A penumbral patch to the S.; f. spot normal.
14. Nearly circular; a tiny stream of dots within the penumbra. The patch still visible; f. spot splitting up.
15. Outline hexagonal, diameter 1′ of arc. Two nuclei bursting out on the S. side, where the dots were observed.
16. Little change.
18. Normal, circular, no f. spot, and hardly any outliers.
19. Another small detached nucleus within the penumbra.
20. Pear-shaped, breaking up at the extremity.
21. Nucleus cloven.
23. Near W. limb.

April. GROUP 74. *Long.* 315° to 309°. *Lat.* 16° N.
13. Two spots near E. limb, the f. with divided nucleus.
14. The p. broken up into small nuclei, without penumbra, on the f. side.
15. P. more normal, but tapering to the W., contrary to the usual direction; the f. double. Outliers between the two.
16. The p. elongated; the f. crescent-shaped, with adjacent scattered nuclei.
18. Nucleus of p. splitting lengthwise; two small spots thrown off. The f. become four distinct spots.
19. The p. more normal; the cast-off spots more distant. The f. reduced to one and a stream of dots.
20. Little change in the main spot.
21. One spot adjacent to the main, and one or two at a distance.
22. The adjacent spot re-united to the main, which is broken up to the E.
23. No radical change.
24. Nucleus bridged.

April. GROUP 75. *Long.* 8°. *Lat.* 18° S.
13. A pair of dots near the central meridian at 9.30 a.m. A little stream of dots at 6 p.m.
14. One nuclear spot, and one f.

April. GROUP 76. *Long.* 358°. *Lat.* 17° S.
15. Three or four spots, and a tiny stream of dots.
16. A few widely scattered spots,
18. A more compact group, two spots with a little penumbra.
19. Great increase in the two spots.
20. A zigzag of six or more smaller spots.
21. Decreasing, near W, limb.



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April. GROUP 77. *Long.* 270°. *Lat.* 24° N.

16. A spot close to E. limb at 8.20 a.m.
18. Penumbra chiefly to the N. and S.
19. A small nucleus in addition to the large one.
20. Little change.
21. Small nucleus still visible.
22. Larger nucleus divided, signs of breaking up. Penumbra to the N. and S. only.
23. Decreasing at 8 a.m. At 4.30 p.m. reduced to a scattered group of insignificant spots.
24. Positions altered, spots in the form of a kite.
25. Positions again altered, two pairs of sharp dots with one penumbral spot more N.
26. The pairs of dots more widely separated. (This changeable group became merged into the disturbed region occupied by 78, having decreased as rapidly as the latter increased).

April. GROUP 78. *Long.* 262° to 254°. *Lat.* 20° to 24° N.

18. A very small spot S.f., group 77.
19. About seven little spots in a nearly circular group.
20. Increasing, one larger than the rest, which now form a stream to the S. of it.
21. Spots all small, in three streams, the two most northerly very diminutive.
22. An almost incredible change, no streams, but two spots already large, nearly equal in area, with divided nuclei, angular, about 4° apart, following each other with outlying spots and dots, as if thrown off. At 4.30 p.m. these have filled the intervening space, and show a tendency to curves.
23. A splendid group, still increasing, and somewhat elliptical in outline. The most f. of the two spots has a dense forked nucleus, with filamentary streamers, the penumbra having also increased in proportion, and accompanying the outliers also. At 4.45 p.m. the filaments are more prominent, and a narrow crescent-shaped nucleus caps the oval one of the p. spot. There is also more tendency to fusion in the larger outliers, a host of dots also swarm in the neighbourhood.
24. The two spots again becoming more separated. The nucleus of the p. three-lobed, the penumbra winged. The f. has the nucleus less fimbriated, and split longitudinally. Stragglers to the N. are forming distinct spots, five of them have small beaded nuclei, the dots decreasing.
25. At 8 a.m. the p. almost split in two with the penumbral wings detached. The f. with nucleus entire and penumbra chiefly to the S. Outliers all on the wane, two only with nuclei, the f. in a stream. At 5.45 p.m. the p. still more divided, the detached penumbra gone, with trains of dots in its place. F. spot more circular, less vertical, but jagged in outline. Outliers more in a cluster.
26. The p. decreasing, penumbra only to the N. The f. tapering, penumbra N. and S., some patches thrown off. Outliers fewer and altered in position.
27. Nearing W. limb. The f. spot larger than the rest.
28. Spots much reduced. The f. with divided nucleus, penumbra on the p. side.
29. Close to W. limb at 8 a.m.

April. GROUP 79. *Long.* 237°. *Lat.* 15° N.

19. A normal spot, penumbra on the f. side.
20. Major axis about 20″. Penumbra to the N. and S. only.
21. Penumbra chiefly confined to the N.
22. Nucleus triple, two very small spots f.
23. Four dots f.
24. More normal and elongated.
25. Very small, two nuclei.



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April. GROUP 80. *Long.* 278° to 273. *Lat.* 6° to 10 S.
20. An elliptical group, more than one day past the centre of disk composed entirely of small spots, increasing rapidly in number.
21. Spots more widely separated.
22. An irregular stream, in three sections, the first composed of dots only.
23. All larger, one spot p., then a semicircle, and lastly a penumbral spot, with jagged nuclei. At 5.30 p.m. more clustered.
24. Again straightened out, spots coalescing with considerable penumbra.
25. Great diminution, about four very small spots.
26. Hardly more than dots, in three sets.

April. GROUP 81. *Long.* 190°. *Lat.* 15° S.
20. A very small spot in a great mass of faculæ, p. by two dots.
21. Three very small spots, faculæ stretching far southwards.
22. A normal spot.
23. Little change.
24. Major axis about 30″.
25. A few spots p. and f.
26. More inclined to the equator.
27. Elongated, penumbra to the N., two adjacent spots.
28. Nucleus narrow, nodular. A faint spot p. at some distance.
29. Penumbra still to the N. only. Nucleus divided, a little vertical train p.
30. Completely broken up, p. spot nuclear.

May.
1. Hardly visible.
3. One small faint spot.

April. GROUP 82. *Long.* 210° to 202°. *Lat.* 20° S.
22. A pair of very small spots, S. p. Group 81. Faculæ observed in the same position previously.
23. At 8 a.m. a little curved stream; at 4.30 p.m. more numerous. A cluster of dots at the rear.
24. One spot larger.
25. Four very small spots forming a trapezium.

April. GROUP 83. *Long.* 210° to 198°. *Lat.* 8° N.
22. A few very small spots not far from E. limb.
23. Four little spots in a quadrangle p. an angular group; f. increasing in the course of nine hours.
24. A well defined spot with three nuclei in a curve p. An irregular train of penumbral incipient spots f.
25. The p. A. almost normal, pear-shaped, penumbra gaping at the end, the f. spots very scattered, one, B., much larger than the rest, in length nearly equal to A. Nucleus wedge-shaped. Many outliers.
26. A. nearly circular, major axis 45″. B. more regular. Some of the outlying spots contiguous in front, the rest decreasing in area.
27. No details.
28. A. with a tail-like appendage, oval. B. breaking up, partly composed of a circle of tiny nuclei. Outliers fast disappearing.
29. A. normal, circular. B. greatly reduced.
30. Little change in A. B. vanished.

May.
1. No details.

April. GROUP 84. *Long.* 201°. *Lat.* 16° N.
23. A quadrangular group of very small spots N. of Group 83.
24. In a semicircle. Some with slight penumbra.
25. In two sets.
26. More of a stream.
27. No details.



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April. GROUP 84—*continued.*

28. Spots smaller and fainter, except the most f., which has rapidly increased, and is now 30″ of arc in length, oval, with several nuclei. Some hours later with penumbra only on one side.
29. Very few p. spots, the f. nearly circular, penumbra closing in all round.
30. Once more an irregular stream, the f. spot very small, possibly divided.

April. GROUP 85. *Long.* 160° to 152°. *Lat.* 22° N.

24. A considerable spot near E. limb, penumbra on the f. side.
25. Tapering, small spots S. f.
26. Nearly normal, f. spots more numerous.
27. No details.
28. Nucleus divided, f. spots forming a train expanded at the end.
29. F. spots much reduced.
30. More vertical, nucleus splitting, f. spots almost gone, but some new ones nearer in a semicircle.

May.

1. Broken up into fragments.
3. Surprising increase, a regular spot with major axis 45″, and bridged nucleus followed by two rather smaller and close together, with penumbra S. p.
4. The p. little changed, the f. decreasing and broken up.
5. The p. only left, penumbra gaping to the W.
6. Near W. limb.

April. GROUP 86. *Long.* 150°. *Lat.* 2° N.

28. A stream of small spots and dots. Faculæ observed in the same position on the 25th and 26th.
29. Almost a zigzag, first and last only penumbral.
30. The p. well defined, nucleus convex to the W.

May.

1. More normal, major axis 30″, two nuclei, three of the f. in a row, intermediates disappeared.
3. A small pair p. A very nebulous spot f.
4. Still more reduced.

April. GROUP 87. *Long.* 138°. *Lat.* 19° S.

27. A few very small spots near E. limb.
28. In two sets.
29. The most p. much larger, oval with beaded nuclei, length nearly 30″.
30. More circular.

April. GROUP 88. *Long.* 190° to 187°. *Lat.* 25° N.

28. A few little spots N. f. Group 84.
29. A pair, nebulous.
30. The most f. smaller.

April. GROUP 89. *Long.* 158°. *Lat.* 23° N.

28. Three very small spots S. p. group 85.
29. One rather larger.
30. A miniature cluster, spots dark and close together.

April. GROUP 90. *Long.* 137°. *Lat.* 10° to 19° S.

28. A few very small spots in a stream.
29. A pair to the S., forming a triangle.
30. Immense increase, at 8 a.m., many small nuclei with a little penumbra forming an irregular ellipse. At 6 p.m. further increase. The ellipse almost filled up with a maze of nuclei, penumbra and dots intermingled.



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May. GROUP 90—*continued.*

1 The maze resolved into a compound spot with crescent-shaped nucleus p., between the cusps two dots set in a bright vacancy, the f. portion containing a serpentine nucleus; almost contiguous two irregular penumbral spots which have apparently shifted northward since yesterday. Some outliers larger and more distinct.

3. The compound spot more normal, with one nucleus still curving westward, but lobster-shaped. The f. contiguous spots united into one with penumbra only on one side, but more distant, as if repulsed; small outliers in curves and streams, one p. larger than the rest.

4. The large spot ear-shaped, major axis 1′ of arc. The f. more normal, nucleus intersected. A stream to the N.

5. Large spot triangular with luminous bridges, the f. with dense nucleus. Outliers decreasing.

6. Large spot with two-lobed nucleus, the f. united to it at the extremity. Two nuclear spots f. and one p.

7. Spots more united, outliers almost gone.

8. Near W. limb, apparently single. A well defined patch of faculæ to the N.

April. GROUP 91. *Long.* 93°. *Lat.* 20° S.

29. A normal spot near E. limb.

30. Little change.

May.

1. No details.

3. A pear-shaped spot, nucleus blunted at one end, tapering and disjointed at the other.

4. More normal, the tapering portions almost severed.

5. Nearly circular, two nuclei, the severed portion becomes a small distinct spot.

6. Nucleus with a tail curling round, apparently from the union of the two nuclei. The distinct spot gone or re-absorbed into the larger.

7. Nucleus again divided, a break also in the penumbra.

8. Nucleus elongated, nodular, a portion once more thrown off, forming a spot.

9. Little change, spot thrown off much decreased.

10. Nucleus with one division, no f. spot.

11. Near W. limb, normal.

April. GROUP 92. *Long.* 78°. *Lat.* 21° S.

30. A small but regular spot near E limb.

May.

1. No details.

3. Major axis nearly 30″, nucleus angular, penumbra wider on the f. side, a zigzag of small spots S. p., and a more vertical stream following.

4. Nucleus stretching out longitudinally, spindle-shaped, penumbra nearly equal on both sides, a few outliers; the p. zigzag reduced to two spots, the vertical stream lying parallel to it, chiefly dots.

5. Little change in the main spot, the p. outliers now a miniature stream of dots, the two little spots somewhat increased.

6. The main spot much narrower, the dots become a balloon-shaped spot.

7. Decreasing, truncated, p. spot gone.

8. Nucleus triangular.

9. Much smaller, circular, nebulous.

10. Penumbra on the f. side.

May. GROUP 93. *Long.* 141°. *Lat.* 9° N.

3. A single small spot, S. f. Group 85.

4. A semi-elliptical group, chiefly dots. On the f. side a stream of dots.

5. Three dots in an equilateral triangle, one of them a pair.



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May. GROUP 94. *Long.* 59° to 46°. *Lat.* 24° to 30° S.

3. (This group showed features of special interest throughout its course.) Three nuclear spots near E. limb closely following each other, with one or two more to the S.
4. The spots p. much increased, especially the second, which has many small nuclei, and curves round to the E.; an elliptical group f, almost entirely made up of dots.
5. The three p. spots distinct, each with a single nucleus, the central one double the size of the other two, which are singularly alike, but with penumbra only on the side exterior to the central spot, another instance of apparent attraction and repulsion exercised by adjacent spots. The ellipse has disappeared, one nuclear spot and a minute cluster of dots only left.
6. More rapid changes; the group is now a train, in four sections, the two most p. being fresh outbursts and composed of many small nuclei streaming in opposite directions, with very little penumbra. Of the three spots of yesterday, the third section, only two remain, a few dots following at a little distance.
7. The new p. spots enlarged, forming two curved streams; the two f. spots are closer together, the smaller one still with penumbra only on the outer side. The larger normal, with a dense nucleus.
8. The two streams condensing, the first now contains a full-grown spot crowded with nuclei, the second is more irregular, in one place curved like an S. The larger of the f. spots has coalesced with the smaller, leaving only a vacant space between the nuclei. Thus only three of the four sections remain.
9. First stream reduced to a single spot, the nuclei still numerous, and forked at the end, the second dwindling. The f. spot has the p. portion again dissevered. This must have taken place between 5 p.m. of the 8th and 7.15 a.m. of the 9th.
10. The p. spot triangular, the fork resulting in two nuclei. The second more scattered, the third a double spot.
11. First spot with three nuclei decreasing, second almost gone. Third with the dissevered portion elongating.
12. Yet another change, the first spot split in two, a new one about 2° to the E. of it, almost normal, and as large as the preceding, the third with nucleus bridged over. Only one small attendant. There are now three spots in the group almost equal in area.
13. The p. spot little changed, the new one less than a quarter of the size it was yesterday, the f. normal.
14. Only the f. spot visible.

May. GROUP 95. *Long.* 52°. *Lat.* 15° S.

3. A small nuclear spot near E. limb.
4. More irregular.
5. Nucleus divided, penumbra chiefly on the p. side, a miniature stream following.
6. Normal, major axis nearly 30″. No stream seen.
7. Smaller, nucleus double, miniature stream again visible.
8. Penumbra still on the p. side, no stream.
9. Nucleus dividing at the end.
10. Little change.
11. Much decreased, a new and similar spot 3° more E.
12. One very small spot, nucleus hardly perceptible.
13. Smaller and fainter.

May. GROUP 96. *Long.* 46°. *Lat.* 7° S.

3. A very small nuclear spot (half the size of 95). Same position as Group 67.
4. More nebulous.
5. A little increased, penumbra on the p. side.



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May. GROUP 96—*continued.*

6. Little change.
7. Dwindling rapidly.
8. A little increase, a very small spot following.
9. Little change.
10. Decreasing.
11. A very small spot without penumbra.

May. GROUP 97. *Long.* 120° to 110°. *Lat.* 15° to 18° N.

5. Three very small faint spots past the central meridian, observed on the 4th by Prof. Pereira as pores only, faculæ also seen near the centre of disk.
6. A spot, with penumbra only to the N., major axis about 20″. At some distance a small cluster.
7. Almost normal, the f. cluster increasing. Three new spots between.
8. Nearing W. limb, spots more numerous, forming an irregular train without any increase in area.
9. One small spot near W. limb.

May. GROUP 98. *Long.* 357°. *Lat.* 13° S.

7. A normal spot, major axis about 30″.
8. Little change.
9. Somewhat increasing.
10. More elongated.
11. Nearly circular.
12. Tapering off at the extremity.
13. Normal, major axis 40″.
14. No details.
15.
16. Not observed.
17. Not observed.
18. Not observed.
19. Near W. limb, very small.

May. GROUP 99. *Long.* 331°. *Lat.* 13° S.

8. A nuclear spot very near E. limb at 5 p.m. (A return of 78. A single spot.)
9. Penumbra chiefly to the N. and very transparent, only the outline pronounced. (The Rev. F. J. Eld says, "Has every appearance of being a depression.")
10. Normal.
11. Little change.
12. Nucleus inclining to the equator. One or two outliers.
13. Pear-shaped, length 40″; four little spots to the N., one p.
14. Too hazy for details.
15.
16.
17.
18. Much decreased. This spot resembles 98 in character and also in decreasing when approaching the W. limb.

May. GROUP 100. *Long.* 313° to 307°. *Lat.* 13° S.

11. Two very small spots in the midst of faculæ at a little distance from E. limb.
12. Slight increase.
13. Three pairs of small spots, widely separated.
14. No details.
15.
16. An irregular train of small spots, in five sections.
17.
18. Train increased, serpentine, one of the p. spots distinct from and larger than the rest, the f. becoming confluent.



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May. GROUP 100—*continued.*

19. Train much expanded at the end, nuclei all small with irregular penumbra, giving a lace-like effect to the whole; the p. spot now merged into some small ones to the N., forming a double spot with six nuclei.
20. P. spot much larger, with four nuclei in a row. The f. spots all connected and stretching out longitudinally, with branching arms, two of the nuclei larger than the others.
21. P. spot with penumbra on the p. side, umbra more entire. The f. still branching to the N., but with quite a distinct spot to the S.
22. Very near W. limb; decreasing. Spot to the S. not disconnected.

May. GROUP 101. *Long.* 68°. *Lat.* 12° N.

11. A very small spot only two or three days from W. limb, at 7.15 a.m. At 5 p.m. a star-shaped tiny cluster of dots.
12. Two rather larger spots, widely separated.
13. A pair.

May. GROUP 102. *Long.* 29°. *Lat.* 20° N.

11. Two pairs of very small spots near the centre of disk.
12. One pair rather larger.
13. Four little spots in a square, later in the day three in a row.

May. GROUP 103. *Long.* 330°. *Lat.* 29° S.

19. Two sets of small spots, widely separated.
20. A close pair, in a great extent of faculæ.
21. A still closer pair. Near W. limb.

May. GROUP 104. *Long.* 281°. *Lat.* 17° N.

19. A round nebulous spot near the centre of disk.
20. Fainter.

May. GROUP 105. *Long.* 269°. *Lat.* 21° N.

19. A spot very similar to 104.
20. Fainter.
21. Still fainter and smaller.

May. GROUP 106. *Long.* 187°. *Lat.* 12° N.

20. A small spot near E. limb, penumbra N. f.
21. Increasing, penumbra equal on both sides. Nucleus double, a small spot, with double nucleus, following.
22. Nucleus almost entire, f. spot decreasing.
23. Normal, nearly circular, the f. spot much larger.
24. A few outlying spots.
25. Oval, breaking up at the extremity, and followed by a train of small spots, some penumbral, some only dots.
26. Rather smaller, f. train consisting of four spots only, altered in position.
27. Little change, f. spots again altered in position and more numerous; one larger than the rest, with a double nucleus.
28. Major axis about 30″. Still tapering at the end. Three spots only following.
29. Reduced more than half. Penumbra on the p. side. One spot f.
30. Nearing W. limb.
31. Near W. limb.

May. GROUP 107. *Long.* 165°. *Lat.* 16° S.

21. A small spot with slight penumbra, near E. limb.
22. Two nuclei.
23. Almost without penumbra, a few stragglers, and one spot following at some distance.
24. Little change.
25. An irregular group, three spots with penumbra, the rest dots.



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May. GROUP 107—*continued.*

26. A fan-shaped cluster, spots all small and intermixed with penumbra, a few new ones f.
27. Spots more dispersed, forming a zigzag, one only penumbral; four following at right angles to each other.
28. Spots reduced to dots, the p. in a zigzag, the f. in an ellipse.

May. GROUP 108. *Long.* 211° to 204°. *Lat.* 14° N.

23. An oval spot closely followed by a tiny stream. A few outliers to the N.
24. No increase, f. spots more numerous.
25. A double spot, the four spots, or nuclei, of the tiny stream now curled round the larger one, with penumbra only on one side, as if attracted to it.
26 Spot no longer double, penumbra to the N. Spots in three sets, the second and third consisting of two pairs of nuclear spots. Eight hours later further change, the second set having three spots, the third a crescent-shaped string of nuclei with very little penumbra.
27. Leading spot still with penumbra to the N. In the third set the nuclei have coalesced and formed a regular spot, the crescent being still perceptible.
28. Two spots only conspicuous, both at least 30″ of arc in major axis, and with penumbra on the p. side.
29. Leader much decreased, penumbra again only to the N., f. almost gone.

May. GROUP 109. *Long.* 163° to 153°. *Lat.* 24° to 25° N.

22. A small spot, which proved a remarkable one, in the midst of faculæ near E. limb.
23. Much increased, nearly 30″ in length; smaller spots following.
24. Leading spot normal, with three nuclei, those f. more numerous.
25. Immense increase. Two compound spots. The leader 50″ of arc in length dividing centrally, the f. with one circular nucleus and smaller ones in curved streams. Later in the day further change and enlargement.
26. Leader double, pear-shaped, with two-lobed curved nuclei. F. spot very irregular, and changing rapidly.
27. Leader obovate, nuclei surrounding a vacant central space. F. spot equal in size, much curved, with pointed nuclei.
28. Leader again two-lobed, but in the opposite direction, with four narrow sharp nuclei and vacant spaces between them, a rare combination; f. spot more normal, nucleus angular and cloven. A few outliers.
29. Leader greatly altered; drawn out like a caterpillar, with a single row of nuclei; f. spot also elongated but in shape more normal.
30. Leader in three portions, f. spot expanded, curved round at the end.
31. Spots all more separated, in the p. portion the central the largest, in the f. the foremost, those at the rear curved in an opposite direction from that on yesterday.

June.

1. Leading spot quite distinct and much reduced, the f. only three, more widely separated and at right angles to each other.

May. GROUP 110. *Long.* 167°. *Lat.* 13° S.

23. A small spot near E. limb, f. Group 107.
24. Two small spots.
25. One spot, a fresh one at some distance to the S.



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May. GROUP 111. *Long.* 206° to 200°. *Lat.* 19° S.
25. An irregular train of five small spots, past the centre of disk, widely separated, rapid changes taking place in a few hours.
26. The p. spots 'gone, the f. has two much increased, nearly 30″ of arc in length, many fragmentary outliers.
27. The two larger spots very irregular, fewer fragmentary ones.
28. The p. spot with three nuclei and penumbra only to the W. The f. in two parts, penumbra on opposite sides.
29. Fast decreasing, spots all insignificant.

May GROUP 112. *Long.* 128° to 124°. *Lat.* 15° S.
25. Five very small spots not far from E. limb.
26. Two small spots.
27. An incipient spot composed of a cluster of about six nuclei, two faint spots following.
28. Cluster splitting up.
29. Two pairs of small spots, widely separated.

May. GROUP 113. *Long.* 106°. *Lat.* 11° S.
25. Two very small spots near E. limb.
26. Faint, little change.
27. No increase.
28. One small spot.

May. GROUP 114. *Long.* 92°. *Lat.* 20° S.
26. A large spot close to E. limb (at 5.15 p.m.).
27. Nearly normal, penumbra in excess to the S. but nearly equal on either side.
28. Two nuclei without central penumbra. A few outliers and a nuclear spot to the N.
29. More normal, nuclei nearly equal, but still distinct, no division in the penumbra.
30. Little change.
31. Three nuclei, outliers more numerous.
June.
1. A stream of white matter observed by Prof. Pereira, at 7 G.M.T., cutting through the penumbra to the umbra. Central nucleus smaller.
2. Nuclei again more equal. Some penumbral spots to the S.
3. Nuclei more separated, outliers streamlike.
4. Nuclei splintered, outliers only to the S. connected together by penumbra.
5. Foreshortened, cloven, in the form of an elongated horseshoe, the nuclei breaking up. Only two small outliers.
6. Nuclei still more broken; outliers in a stream.
7. Spot split into three; no outliers.
6. Close to W. limb.

May. GROUP 115. *Long.* 84° to 77°. *Lat.* 19° to 23° S.
28. A large compound spot with small nuclei and much penumbra, near E. limb.
29. About eight nuclei, interspersed with penumbra, a detached portion similar in character following.
30. No details.
31. F. spots more scattered, penumbra hazy, confined to the centre.
June.
1. A large spot in process of formation by the aggregation of as many as eight scattered nuclei, one of those, near the centre, horn-shaped. The f. portions of the group with penumbral spots, but more diffused.
2. Leading spot condensed, nuclei coalescing in a curved line. F. spots increasing in number, those to the N. beginning to form a separate elliptical group.



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June. GROUP 115—*continued.*

3. Three nuclei of the leader larger than the rest with a great amount of penumbra; f. spots still more numerous.
4. The group may now be broadly divided into four parts or clusters, the leader still maintaining its distinctive character, two nuclei predominating, curving in opposite directions, the rest very small. The three f. clusters are composed of loose fragments, nuclei and penumbra being mixed up together in almost equal portions.
5. Leader with the principal nucleus much drawn out and fimbriated, more united as a whole. Prof. Pereira describes it as a noble group, full of detail, defying all drawing (much more description), and changing every minute. The most f. cluster amalgamated and showing cyclonic action. Total length (including 114) 400″.
6. Leader gaping in the centre. It is worthy of note that there are now four spots on the disk at once, showing these central gaps, a sort of horse-shoe appearance, but with the openings in different directions. The clusters are now dispersed. One spot, the most northerly, is nearly normal, the last has three lobes with beaded nuclei, one of them protruding arm-like. In the most southerly cluster, only two spots remain out of the swarm observed yesterday.
7. Much foreshortened, all the spots splitting and diminishing, except the last, which has lost its lobes, but has spread out and become two spots, lying side by side.
8. P. spots altered in position, the most northerly curved away from the limb, with penumbra on the p. side. The two large f. spots still more divided and branching upwards.
9. The most p. spots invisible, the large ones still in a long line.
10. Quite invisible at 4 p.m.

May. GROUP 116. *Long.* 77°. *Lat.* 10° N.

28. A small normal spot near E. limb, penumbra nearly equal on both sides.
29. Penumbra on the f. side.
30. Normal.
31. A few small outliers.

June.

1. Nucleus somewhat quadrangular.
2. Circular.
3. Little change.
4. Diameter not more than 20″.

May. GROUP 117. *Long.* 55°. *Lat.* 11° N.

30. A normal spot with a lesser one, f. near E. limb.
31. A few outliers.

June.

1. A stream of small spots f.
2. Not observed.
3. Several penumbral spots in a curve, the last the largest.
4. A little compact train.
5. More separated.
6. In two sets. The p. very small, the f. confluent, gaping to the E with five nuclei.
7. More dots p. The f. spot gaping in the opposite direction, on the wane.
8. Dots fewer and altered in position. F. spot more vertical, one nucleus.
9. Dots condensed into a penumbral spot with double nucleus, f. spot with very little penumbra left.
10. One spot.



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June. GROUP 118. *Long.* 58°. *Lat.* 17° S.

3. A penumbral spot with a few outliers f. Group 115.
4. Two-lobed, nucleus divided, major axis 30″.
5. No details.
6. Nucleus double.
7. Little change.
8. Penumbra on the p. side.
9. Much reduced.

June. GROUP 119. *Long.* 7°. *Lat.* 15° S.

2. Two very small spots not far from E. limb.
3. Three, in a triangle.
4. The most f. larger.
5. Little change.
6. Spots in two sets, the p. containing six or seven in a double curve, with but little penumbra, the f. a miniature cluster, chiefly dots.
7. One spot, almost normal, with crescent-shaped nucleus p., only one other spot forming the curve left. F. three small spots.
8. One spot only, nucleus regular, penumbra on the N. p. side.
9. Normal and circular.
10. Dwindling.
11. Still smaller, nebulous.
12. Again reduced.
13. Very small, in the midst of faculæ.

June. GROUP 120. *Long.* 43°. *Lat.* 18° N.

4. A spot, major axis about 25″, almost normal, nucleus cone-shaped, a few small outliers in a curve considerably to the S.
5. No details.
6. Nucleus more oblong, outliers gone.
7. Nucleus more tapering.
8. Little change.
9. Normal.
10. More pointed to the N.
11. Near W. limb, decreasing.

June. GROUP 121. *Long.* 335° to 326°. *Lat.* 12° N.

6. Two spots not far from E. limb, the p. with blunted nucleus and penumbra to the S. The f. twice as long, penumbra N. f., some broken fragments to the S.
7. The p. spot throwing off fragments, the f. absorbing them; penumbra all round.
8. The p. with the fragments widely scattered, as if exploded. The f. increased, with four nuclei.
9. A fresh nuclear spot in advance. The fragments of the p. fewer. The f. spot curved, with three adjacent outliers.
10. P. spots again altered, fragments reduced to dots. F. spot with five nuclei in a crescent, the largest outlier gone.
11. The most p. spots in a circle, with one in the centre. The dots misty and scarcely visible. F. spot with the nuclei more condensed, and a semi-detached portion in front, major axis 45″.
12. One p. spot only, nebulous. The f. bridged across the centre, sputterings to the N.
13. P. spot almost gone, three in advance, a new outburst. The f. with two distinct nuclei. Three small spots also to the N. (relics of the sputterings).
14. F. spot with three nuclei.
15. One of the nuclei apparently thrown off. Main spot tapering and breaking up.
16. A poor remnant, fast tending to extinction, thrown off nucleus just discernible.
17. One very small spot near W. limb.



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June. GROUP 122. *Long.* 320°. *Lat.* 13° S.

5. A normal spot near E. limb.
6. A small spot f.
7. Little change.
8. F. spot with double nucleus and penumbra on the f. side.
9. F. spot, without penumbra.
10. Main spot circular, f. spot gone, a new one N. f.
11. Near centre, elongated equatorially.
12. Two dots f.
13. Little change.
14. Pointed at the extremity.
15. Breaking up at the end into streamers.
16. Little altered.
17. Nucleus bridged in two places.

June. GROUP 123. *Long.* 42°. *Lat.* 18° N.

7. A miniature train of small spots, the last consisting of dense nuclei in the form of a V reversed.
8. Two small spots, widely separated.
9. The f. spot gone, a larger one to the S. At some distance S. f. two more, small and nebulous.
10. One normal spot, length about 20″.
11. Smaller.

June. GROUP 124. *Long.* 311°. *Lat.* 11° to 15° S.

7. A small spot not far from E. limb.
8. Two spots N. and S. of each other, penumbra of each pointing northwards.
9. Many smaller spots and dots, the uppermost only with a little penumbra, at 9 a.m. in the form of a crescent, at 4 p.m. much increased, bending to the S. in the form of an arch.
10. At 4 p.m. the penumbral arch broken up and resulting in two principal spots with a stream of tiny ones between them, another stream curving to the S. Some more very small spots have appeared to the N.
11. Aspect of the group entirely changed, spots more longitudinal and distinct, one larger than the rest.
12. Spots to the N. reduced to two, one with a double nucleus, the larger spot much drawn out, penumbra only to the N., nucleus uneven, giving it the appearance of the larva of an insect, the nuclear spot below it with penumbra on the opposite side, just the reverse of yesterday; outliers fewer.
13. The larva-like spot more normal, but still one-sided, outliers again more numerous.
14. Larva-like spot breaking up, outliers decreasing.
15. Still greater reductions, only four of the nearer outliers remain, group now triangular.
16. Original spots only visible as a nebulous patch, a new vertical group has appeared to the N. consisting of small spots in three sets.
17. Spots greatly enlarged and almost confluent, the most northerly bigger than the rest, with dense splintered nucleus and intricate structure, the most southerly with penumbra on the p. side.
18. The three sets again more distinct, but still vertical, their components inclining to the normal type, about five in number. Near W. limb at 7.30 a.m. Not visible 24 hours later.

June. GROUP 125. *Long.* 303°. *Lat.* 18° S.

10. A penumbral spot S. f. group 124, not observed on the 9th.
11. Nucleus double.
12. A small spot f.
13. Decreasing, nebulous, no f. spot.
14. Two spots.
15. One spot.
16. Some scattered dots f.
17. Two very small spots.



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June. GROUP 126. *Long.* 302° to 296°. *Lat.* 16° N.
11. At 9 a.m. A faint spot about three days E. of the centre of disk; later a wide pair.
12. The p. spot triple, with slight penumbra, two small ones f. in a triangle.
13. P. spot double, four or five f.
14. Spots increasing in number.
15. A widely scattered stream of very small spots and dots, the three most p. forming a triangle. To the N. a wide pair of dots.
16. The p. a pair, close together, and only three f. Those to the N. gone.
17. A miniature cluster. At 2.30 observed as two spots by Rev. F. J. Eld.
18. Spots again dispersed; surrounded with faculæ.
19. Two considerable spots, the most northerly normal, with double nucleus; the southerly with penumbra on the f. side.

June. GROUP 127. *Long.* 291° to 283°. *Lat.* 18° to 22° S.
13. Two pairs of small faint spots at some distance from E. limb.
14. Rather more in number but still inconspicuous.
15. Enormous increase (in extent 2,400 square seconds). A leading spot nearly 30″ major axis, the rest of the group composed of 22 or more small nuclei, with a fair amount of penumbra in three streams forming an irregular triangle.
16. A web-shaped cluster, much increased in area and spreading northwards, nuclei more numerous and larger. Leader nearly normal.
17. More than 30 nuclei, penumbra increased and embracing the greater proportion, leader hardly larger than the rest, group spreading laterally, penumbra very delicate.
18. Cluster condensing and forming one large spot with several nuclei, the f. portion with an excess of penumbra and an ellipse of sharp dots at the rear.
19. Much foreshortened, the large spot with the three nuclei immensely reduced, and penumbra in a curve only on the p. side, other spots more dissevered and on the wane.
20. Close to W. limb at 5.40 p.m., a great extent of faculæ in the neighbourhood.

June. GROUP 128. *Long.* 266° to 260°. *Lat.* 14° to 15° N.
14. Two small spots about 26° E. of centre.
15. Three, the leader the largest, and nebulous.
16. Leader double, two new spots f. in a line.
17. The most f. spot the largest, with slight penumbra, the rest hardly more than dots.
18. An increase in number but not in area.
19. Two small spots widely separated.
20. One spot.

June. GROUP 129. *Long.* 218° to 211°. *Lat.* 17° N.
14. A small nuclear spot not far from E. limb, in the midst of faculæ.
15. Penumbra only to the N.; two or three small attendants on the f. side.
16. Penumbra to the S.; faculæ very extensive as far as the limb. A very small spot at some distance p.
17. Larger, nebulous, penumbra again to the N.; one f. spot and two or three dots at a considerable distance.
18. Smaller, nucleus double, penumbra slight; a few dots f. in a triangle.
19. One very faint spot.

June. GROUP 130. *Long.* 210°. *Lat.* 15° S.
14. A very small spot not far from E. limb; many faculæ.
15. A nuclear spot, area nearly equal to 129.
16. Dwindling, two dot-like nuclei, faculæ still surrounding.
17. A tiny stream resembling a comet.
18. Comet-like tail reversed.



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June. GROUP 131. *Long.* 230° to 220°. *Lat.* 16° N.

18. Three sets of very small spots widely separated, the first and last pairs.
19. Only two spots conspicuous.
20. A somewhat elliptical train of many small dark spots with slight penumbra.
21. Wonderful increase, a large spot, with penumbra on the p. side only, two streamers leading the way; a still larger one, almost normal, but with penumbra cloven to the S., f. at some distance; between the two a double stream of lesser spots. N.B.—The only group of any importance visible at this time.
22. Leader still one-sided, f. spot more than 1′ of arc in length, elongated equatorially, with small nuclei streaming from it in front; intermediate spots in a single stream; whole group much lengthened out.
23. Leader decreased, intermediates increased and becoming distinct spots. F. spot with a portion dissevered and penumbra on the f. side.
24. Nearing W. limb. Spots in three sets; leader with fragments to the S., only one intermediate with penumbra p. The f. more broken up, penumbra f.
25. The f. spot alone visible at 9 a.m.

June. GROUP 132. *Long.* 224° to 220°. *Lat.* 1° to 3° N.

18. Two very small spots near the centre of disk.
19. The most p. now three dots.
20. Not seen.
21. One spot.
22. A parallelogram of small faint spots.
23. At 8 a.m. parallelogram still visible, to the N. of it two crescent-shaped strings of nuclei with a little penumbra in a semi-ellipse. Ten hours later differently disposed. The two crescents have become two spots, facing each other, their penumbra on opposite sides, the most p. nearly normal, the f. with four divisions, as if four spots were in course of formation.
24. The p. split in two, the f. one large spot with several nuclei and penumbra closing round a vacant central space. Three very small spots f. at some distance.
25. The f. spot near W. limb looped, irregular, and enlarged, very near limb at 6 p.m.

June. GROUP 132*. *Long.* 193°. *Lat.* 21° to 23° S.

20. Two pairs of small nebulous spots not far from the centre of disk. They were not seen on the 21st, but some very small spots in two sets on the 22nd were probably the same.

June. GROUP 133°. *Long.* 140° to 135°. *Lat.* 15° N.

22. Two small spots in the midst of faculæ.
23. Both much enlarged, the first nearly normal, the second with tiny nuclei in a globular mass and a comet-like penumbral tail.
24. First spot more broken up, second much decreased, a new one between the two.
25. Four distinct spots; the first split in two.
26. Three very small spots.

June. GROUP 134. *Long.* 185°. *Lat.* 15° N.

23. Two small nuclear spots, some distance apart, past the centre of disk.
24. One spot reduced, the other a pair.



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June. GROUP 135. *Long.* 139° to 130°. *Lat.* 10° to 13° S.

23. At 8 a.m. a miniature cluster of nuclei, two spots f. in a line, the last a pair. Ten hours later more in number.
24. At 6 p.m. a beautiful stream in a double curve, the leader nearly vertical, with two irregular nuclei and penumbra on the p. side, length 40″ of arc. The f. spots with but little penumbra, dark and pointed.
25. Nearly on the central meridian, leader less vertical, ear-shaped, with one large nucleus; spots in the middle of the stream fewer but larger, rapid changes taking place, those at the rear curling round and forming a large compound spot with sharp nuclei; penumbra only on the S. f. side.
26. Group now consisting of three large spots, four of the smaller ones having united in the course of twenty-four hours, and become a cone-shaped spot, in length nearly equalling the leader; the last spot more developed, with one large nucleus and small ones in two beaded strings.
27. Further change, leader broken up, and composed of two spots with sputterings on the f. side; the middle spot has vanished unless, as seems probable, it has been drawn towards the leader and become the supplementary spot; the last is now ear-shaped and more vertical, the small one to the N. of it balloon-shaped.
28. The northerly spot has apparently been drawn in to the centre of the last.
29. All decreasing, the leader with two nuclei, penumbra still on the f. side, seven dots in a vertical stream f.; the rear portion of the group is quite altered, the nuclei are very small, the penumbra is drawn to a point.
30. Chief features again altered, nuclei all small, the most f. spot is once more ear-shaped, but in the opposite direction.

July.

1. Near W. limb, still decreasing.

June. GROUP 136. *Long.* 145° to 133°. *Lat.* 25° to 32° S.

23. At 7.30 a.m., two insignificant spots with a few dots.
N.B.—This group and the foregoing (135) were recent outbursts, not having been observed on the 22nd. Together with group 133 they showed rapid increase at nearly the same time.
24. Two compound spots with closely packed nuclei, major axis of both not less than 40″.
25. Nearly on the central meridian, both spots much thinned out, the p. resembling a bird on the wing, with only one conspicuous nucleus, the f. somewhat similar, with two nuclei, some outliers have appeared between the two and a wide pair of small spots N. f.
26. P. spot more circular, the penumbra hardly more than outlined, the f. broken up into dots like the bursting of a rocket, outliers streaming between the two in a line.
27. All the spots decreasing rapidly, the f. dots more stream-like and altered in position.
28. The p. become two small spots.
29. Group now a curved stream composed chiefly of dots, the leader with slight penumbra.
30. No longer a stream, one spot rather larger.

July.

1. Great increase. Two considerable spots without attendants, the f. twice the length of the p.

June. GROUP 137. *Long* 113°. *Lat.* 22° S.

23. Three faint spots, each with a very small companion.
24. One spot, a few dots f.
25. One spot only.



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June. GROUP 138. *Long.* 77°. *Lat.* 20° S.

24. A small nuclear spot with one or two outliers, near E. limb.
25. Two nebulous spots N. and S. of each other.
26. One larger spot.
27. Little change.
28. More normal.
29. Four or five small spots.
30. Three dots, and one in advance.

June. GROUP 138*. *Long* 82°. *Lat.* 12° S.

27. A few small spots N. p. 138.
28. One spot larger.
29. About five or six faint spots in a stream.
30. Some pointed dots, in three sets, widely separated.

June. GROUP 139. *Long.* 67° to 63°. *Lat.* 22° to 27° S.

25. Four small spots with slight penumbra, position vertical.
26. A crescent-shaped stream, 5° in extent, consisting of many small penumbral spots close together, a separate one N. and S. at either end.
27. Fewer nuclei and more penumbra.
28. Stream more crescented, spot to the S. less distant.
29. Stream broken up, to the N. two very small spots, then a shower of dots, a compound spot with five nuclei, and a lesser one close to it, to the S. two dots only.
30. Almost a cluster from the numerous dots scattered about, the northerly spot increasing, the compound one helix-shaped.

July.

1. A widely scattered zigzag, more inclined equatorially, two penumbral spots, and a V-shaped train of dots only.
2. All dots, the uppermost in a cluster, the remainder forming a triangle, positions quite different to yesterday.
3. Two or three very small spots only.

June. GROUP 140. *Long.* 103° to 94°. *Lat.* 23° S.

25. Two small and nearly equal spots (N. f. 136), widely separated.
26. Another S. f. 30″ in length, normal.
27. Two small spots more p., the normal one reduced to dots; an amazing decrease. Positions of all so changed as to make identification almost impossible.
28. One spot much more in advance, the most f. a pair.

June. GROUP 141. *Long.* 42° to 37°. *Lat.* 16° to 20° N.

27. Two or three insignificant spots near E. limb.
28. Surrounded with faculæ.
29. A striking zigzag of dark spots, in pairs, without penumbra; one more to the S.
30. Spots increasing, all in pairs, or triplets, penumbra very slight.

July.

1. Fewer in number and more scattered, one larger than the rest, egg-shaped.
2. Two of the f. spots larger, the two preceding closer together.
3. Dwindling, more f. spots, all now accompanied by dots, group again more zigzag.
4. Dots disappearing, a new spot to the S.

June. GROUP 142. *Long.* 93°. *Lat.* 22° S.

29. A few little spots in a triangle past the centre of disk.
30. Dots only, three more f. at some distance.



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June. GROUP 143. *Long.* 6°. *Lat.* 18° S.

29. A large normal spot near E. limb.
30. Nucleus forked, penumbra broken to the N.

July.

1. Nucleus apparently about to separate, resembling two bricks, penumbra nearly equal on both sides, very transparent to the N.
2. Nucleus less angular, bridged.
3. More angular, projecting to the S.
4. Vertical, pitcher-shaped.
5. Less vertical, nucleus dividing, a few outliers before and behind.
6. Major axis 50″; very few outliers.
7. Inclined to the equator, nucleus elongating, no outliers.
8. Nucleus bridged in two or three places.
9. Spot in two nearly equal parts.
10. A perfect pair.
11. More N. and S. of each other, near W. limb.

July. GROUP 144. *Long.* 325° to 308°. *Lat.* 5° to 18° S.

2. A normal spot very near E. limb at 8 a.m.
3. Three spots nearly equidistant in latitude, and decreasing in size with the latitude. A, the most southerly, irregular in form and broken at the lower extremity, as if part had been detached. B. and C. more normal, a few thin penumbral spots f.
4. A. with one large nucleus, the lower part still more detached, with three nuclei; four penumbral spots f. A triple spot has appeared near the limb on a line with C.
5. Nucleus of A. quadrangular; the detached portion, with a double row of nuclei again united, but with a vacancy between the two spots in the centre, a striking instance of attraction. B. little changed; C. showing signs of disintegration; the triple spot has become a kite-shaped mass of small fragments, two of the penumbral spots f. A. are much larger, having apparently absorbed the lesser ones.
6. 7.30 to 8 a.m. A. increasing, the lower portion with a single row of small nuclei; f. spots in a stream, the last with the major axis more than 40″. B. tapering. C. little changed; the f. fragments condensed into three miniature comet-like streams. At 6.15 p.m. some decided changes: A. split right across, the large nucleus quadrangular; B. and the last spot (D.) both bridged and larva-like.
7. A. very large, major axis 1′ 30″, nucleus star-shaped, penumbra gaping to the S., the lower portion still adhering on the N. side, the three nuclei more drawn out; f. spots still decreasing, except D. which now equals B. in area. A., B., and D. form an almost perfect triangle, the two latter have also lost the larva-like appearance, their nuclei being more broken and curved. C. has declined rapidly, and is now very insignificant, the f. fragments are also disappearing. (These may be called a secondary train, although to the N.).
8. A. with penumbra gaping in the opposite direction, smaller nuclei, four in a row. B. elongated. C. reduced to a pair of very small spots. D. enormously increased, major axis more than 1′ of arc, the irregular nucleus of yesterday is now much larger, triangular, and unbroken, surrounded by penumbra on all sides, while S. p., and in contact with it is a fresh compound spot, equalling it in length, with a central triangular nucleus, and many small nuclei sprinkled towards the edges. (Mr. Pereira reports that at St. Michael's, Azores, from the 5th to the 10th, the Sun was more or less covered by a heavy haze, and observation impossible. On the 7th, about 4 to 5 p.m. local time, the Sun appeared through the haze as a red orange disk, a rare phenomenon there, which caused great excitement.)
9. Further change, D. has two nuclei, the new spot is no longer contiguous to it, but stretches out in a curious double train composed of penumbra and tiny nuclei, mixed together reaching as



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July. GROUP 144—*continued.*

far as A., which it just touches at one point. The gap in A. has widened, and the lower portion drawn towards the train, so that there is again almost a complete severance. B. is more normal but tapering, a single file of small spots, hardly larger than dots, is all that remains of C. and the fragmentary followers.

10. 9.18 a.m. A. and D. now form a massive train, still double, of angular spots, about nine in number, pretty equal in size, and alternating in latitude, a trail of dots runs parallel with D. at the rear; a spot with double nucleus has appeared to the n. of B. 5.15 p.m. Nucleus of A. triangular, the spots composing the train still in connexion, but more attenuated, a penumbral arm with little nuclei at the end has replaced the trail of dots. D. has nuclei more divided, the final one tapering. B. is breaking up; the N. spot decreased.

11. A. with the lower portion at last quite severed, the train but little altered. D. again more entire as to the nucleus. N. spot with penumbra only on the f. side.

12. Much foreshortened, the train shows signs of breaking up. D. has the nucleus divided on the opposite side.

13. Spots tending more to separation. D. is quite distinct and normal.

14. Nearing W. limb; group now widened out on the p. side.

July. GROUP 145. *Long.* 356°. *Lat.* 20° S.

6. A few very small spots in three sets N. p. Group 144, the first a pair. Three single spots, widely separated and nebulous, were also observed at a considerable distance N. p.

7. One spot, only observed by the Rev. F. J. Eld.

July. GROUP 146. *Long.* 285° to 279°. *Lat.* 17° to 20° S.

6. A small faint spot in the midst of faculæ, another p., still fainter.

7. Both much increased, especially the f., which has four small nuclei, penumbra gaping eastward, major axis 50″. Some outliers N. f.

8. P. more broken up, f. normal, part of the penumbra to the N. almost detached, cap-like in form.

9. P. a train of dots with one leading spot; *f.* pear-shaped, the cap, as it were, slipping off, a train of dots f.

10. P. a single spot, circular, nebulous, f. with rounded nucleus, penumbra branching eastward, a small promontory in place of the cap-like segment. The dots in a zigzag, with slight penumbra, a wide pair of small spots N. f. at some distance.

11. P. gone, f. again pear-shaped, but inclined in an opposite direction, no promontory, two nuclear spots p. The zigzag again more in masses N. f. spots larger.

12. The largest spot inclined to the equator, oval, normal, a few misty wreaths f., N. f. spots not shown.

13. Bridged, N. f. (secondary train) now composed of five dots.

14. Entire. A sinuous stream of five nuclear spots in close proximity, secondary train and f. dots gone.

15. No important change.

16. Large spot split in two, a perfect pair, but with the penumbra of each on opposite sides (a striking resemblance to 143, *see* July 10), two outliers only to the N.

17. The pair now N. and S. of each other (as in 143 when near limb), almost united by penumbra.

18. Close to W. limb at 7.15 a.m.; one spot.

July. GROUP 147. *Long.* 330°. *Lat.* 11° N.

7. Two small spots, with a few attendant dots.

8. One nebulous spot.



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July. GROUP 148. *Long.* 317° to 307°. *Lat.* 9° to 12° N.

7. A group 27° E. of the centre of disk, composed of one crescent-shaped spot, major axis 30″, smaller ones in a triangle, and a stream of dots f.
8. P. spot doubled in area, nearly normal, more small ones scattered about, the f. stream with one dark nuclear spot.
9. P. more elongated, major axis 70″, hooked at the end with two very distinct nuclei, two of the small spots increased; at the rear dots and nuclei in a semicircle, closely connected, but with hardly any penumbra.
10. P. curved in an opposite direction, the terminal hook crescented, detached, and driven back, with three small nuclei, intermediate spots increased, the semicircle transformed into a large quadrangular spot, 40″ diameter, the whole group forming a broad train, the first and last spots being nearly equal in area.
11. Still further change, train almost a zigzag. Leader quadrangular, blunted at the end, the detached crescent being re-united to it at the cusps, middle spots altered in position, with appendages of trailing dots and nuclei, final spot in two segments on the p. side, two-lobed on the f.
12. Much condensed, only five spots in all, the leader a complete trefoil, the final decreased, but more normal.
13. Nuclei of the leader more united, middle spots fast dwindling, final, with nucleus divided, but penumbra entire.
14. Leader more oval, two middle spots only, final split in two.
15. Leader near limb, but greatly decreased, the f. pair very small, no middle spots.

July. GROUP 149. *Long.* 268° to 244°. *Lat.* 13° to 19° N.

7. One or two very small spots smothered in faculæ.
8. Three, with very slight penumbra.
9. A train of six or more, almost a zigzag, the fourth in succession the largest.
10. A new spot in advance, small, but circular; largest spot, with penumbra on the p. side (contrary to what it was yesterday), nucleus square, many more followers, some penumbral.
11. The most p. more to the N. (lat. given for this date) large spot ear-shaped, nucleus divided, three of the f. spots larger.
12. P. spots fast disappearing, more in a line, largest with nucleus entire, inclined to the equator, blunted at the extremity, to which the nearest of the f. spots has evidently been attracted, last spot one-sided, with several nuclei.
13. Large spot much rounded, the one attracted still at close quarters, final spot increased, with three nuclei.
    N.B.—When this attraction takes place the penumbra is generally on opposite sides.
14. Large spot, nearly circular, the junction complete, only a small vacancy left. There are now three nuclei, one quadrangular and jagged, the others linear, outliers altered in size and position, final spot decreasing, only one nucleus.
15. Only glimpsed at 8 a.m., a fine spot more elongated. (Display of auroræ in America on this date.)
16. Surprising change, a compact train (Long. 254° to 246°, Lat. 15° to 18° N.) Leader very large, with three nuclei; f. spots with penumbra threading in and out, an arm-like projection near the centre to the N.; a small spot p. at some distance.
17. Leader more curved and tapering, the f. spots diminishing and breaking up, a shower of dots at the extremity, the arm-like projection also dispersing.
18. Train reduced, but nearly continuous; the portion f. the leader chiefly composed of penumbra, dots gone, an elliptical train of small spots only to the N.
19. Much foreshortened, leader with one nucleus, f. portion reduced and more divided.
20. Near W. limb at 4 p.m., one spot.



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July. GROUP 150. *Long.* 25°. *Lat.* 20° to 21° S.

8. Two small spots. Mr. J. S. Townsend observed a distortion of the C. line, towards the red, over them.
9. About five very small spots among faculæ near W. limb.

July. GROUP 151. *Long.* 262°. *Lat.* 22° S.

8. Two small spots near E. limb.
9. The f. spot penumbral.
10. Three spots p., three f.
11. Two pairs, the first with double nucleus.
12. The p. hardly more than dots, one spot nearly circular f.
13. A tiny pair at some distance p., the f. spot with three nuclei.
14. Two small spots p., the f. breaking up.

July. GROUP 152. *Long.* 249° to 239°. *Lat.* 15° to 18° S.

8. A penumbral spot near E. limb.
9. Nearly normal.
10. A portion breaking off on the f. side.
11. F. portion, with a small nucleus, quite detached. Some small irregular spots 10° more E.
12. Detached portion fast disappearing, one f. spot larger, the rest a swarm of dots. A new spot with double nucleus to the E. There are now four spots nearly the same distance apart.
13. Leader more circular, the f. in a stream, the first and last larger than the rest.
14. Leader little altered, first spot of stream only with penumbra, a secondary stream of faint dots f. in a curve to the S.
15. No details obtained.
16. Two pairs only, the larger with double nucleus.
17. Positions altered, five spots, two with slight penumbra.
18. Three spots in the midst of faculæ.

July. GROUP 153. *Long.* 232°. *Lat.* 5° N.

10. A normal spot not far from E. limb (probaby appearing since 9 a.m. of the 9th).
11. Little change.
12. Nearly circular, penumbra more to the N.
13. Quite circular as to nucleus and penumbra.
14. Little change.
15. No details.
16. Nucleus rather more angular.
17. Little change.
18. Nucleus more uneven.
19. Little change.
20. Still normal.
21. Near W. limb.

July. GROUP 154. *Long.* 218° to 212°. *Lat.* 16° to 16° N.

11. Three small spots near E. limb.
12. At 2.30 a pair, opposite each other, as if one spot had burst in two, a few followers.
13. Almost re-united, f. spots altered in position.
14. One spot, tapering, with disjointed nuclei. A small spot far in advance.
15. No details.
16. Nearly on meridian, three irregular beaded spots at nearly equal distances, a few outliers to the S. No spot in advance.
17. An elliptical cluster, leader much larger than the rest, sliced up the centre between the nuclei, which are increasing, and in two rows; one f. spot only with penumbra, the rest dots or small nuclei, with a tendency to streams to the S., forming another ellipse in miniature.



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July. GROUP 154—*continued.*

18. Leader enormously increased (between 1 p.m. of the 17th and 7.15 of the 18th) major axis 45″ more vertical, with one very large nucleus, the division still existing, a penumbral arm stretching from it to the S. The miniature ellipse, now in two crescents, one composed of singularly small nuclei set close together.
19. Leader more elongated, and inclined to the equator, all the f. spots dwindling, crescents and small nuclei gone.
20. Leader more normal, oval, close to the large nucleus, a brilliant space encircled by penumbra, with two little nuclei to the N., a sprinkling of small faint spots f.
21. Leader still broken at the end. (The Rev. F. J. Eld remarks that this spot showed no foreshortening either on the 21st or 22nd.)
22. No space near nucleus, but an opening in the penumbra to the E. Little nuclei to the N. still perceptible.
23. Very near W. limb, curved.

July. GROUP 155. *Long.* 121°. *Lat.* 26° S.

12. A small spot, with double nucleus N. of 156.
13. No drawings.
14. No increase, nucleus irregular, a curved stream, chiefly dots f.

July. GROUP 156. *Long.* 140°. *Lat.* 32°.

18. Three very small spots not far from E. limb. (Faculæ observed the day previous). The leader increased at 6.48 p.m., G.M.T. (Pereira).
19. Leader decreased, now a pair.
20. A single spot, circular, nebulous, a few very small ones N. p.

July. GROUP 157. *Long.* 108°. *Lat.* 22° S.

19. An elongated spot near E. limb.
20. Nearly normal, an outlier to the N.
21. Little change.
22. Nucleus rather jagged.
23. More procumbent.
24. Nearly circular.
25. A few dots f.
26. Little change; no outliers.
27. Nearly circular.
28. Somewhat kite-shaped.
29. One spot f.
30. Near limb, normal, penumbra rather wider on the p. side.

July. GROUP 158. *Long.* 155° to 151°. *Lat.* 12° to 13° S.

19. A few very small spots.
20. Almost dots, in two sets.
21. Increased in area.
22. A curved stream; very little penumbra.
23. A straight stream; leader larger than the rest.
24. Fewer.
25. A pair, very small, surrounded with faculæ.

July. GROUP 159. *Long.* 141° to 138°. *Lat.* 9° S.

19. One or two extremely insignificant spots.
20. A very small faint spot. Two more, equally small, forming a wide angle with this group and 158.
21. Three spots in a line.
22. Two pairs, rather dense, a little distance apart.
23. Two sets, more widely separated, the most p. with a double nucleus.
24. Decreasing.
25. One small spot.



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July. GROUP 160. *Long.* 88°. *Lat.* 11° S.
20. A spot near E. limb, appearing as a double line at 4 p.m.; an hour or two later as one spot with a double nucleus.
21. A division taking place.
22. Split in two, penumbra on opposite sides.
23. Each half strikingly similar.
24. In contact, more elongated.
25. The p. portion in small fragments, the f. decreased, globular, with four nuclei.
26. A little irregular stream, the f. with one small nucleus.
27. Spots all small.
28. Five little pointed spots in a row, three f. in a line.
29. Two spots.
30. One very faint spot.

July. GROUP 161. *Long.* 73°. *Lat.* 23° N.
21. A penumbral spot near E. limb.
22. Nucleus divided, penumbra on the f. side.
23. Nucleus ear-shaped.
24. Procumbent; nucleus broken at the end.
25. Nucleus entirely broken up; a tiny stream of dots to the S. N.B.—The nucleus of 160 also broke up on the same date.
26. Four spots in a line, the first a pair, the second the largest; length about 20″.
27. A few dots in advance.
28. Decreasing, the f. only with slight penumbra.
29. Very small; a few little spots to the S.

Aug.
1. Two spots.

July. GROUP 162. *Long.* 33°. *Lat.* 16° to 25° S.
26. A small faint spot in the midst of faculæ.
27. Two spots.
28. One spot.
29. No details
30. A pair, and one S. p.
31. Two little pairs, wider apart.

Aug.
1. Three very small spots.

July. GROUP 162*. *Long.* 48° to 45°. *Lat.* 26° to 27° S.
30. A very small pair N. p. 162.
31. Three small spots.

Aug.
1. A very small spot.
2. At 8 a.m. two spots some distance apart. At 11.15 increasing. At 5.45 p.m. the lower one vertical, with a little penumbra.
3. Further increase.
4. Near W. limb.

July. GROUP 163. *Long.* 16°. *Lat.* 29° S.
28. A small nebulous spot some distance from E. limb.
29. Little increase; faculæ round and p.
30. A stream of very small spots almost vertical; the leader a pair.
31. A pair p.; two very faint spots f. at some distance.

Aug.
1. No increase; f. spots not seen.

July. GROUP 164. *Long.* 7° to 12°. *Lat.* 21° N.
29. One very small spot.
30. A few small spots forming a wedge-shaped group. 27° to 30° E. of centre.
31. Three spots, two of them larger, nebulous, penumbra slight.

Aug.
1. No details.



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July. GROUP 165. *Long.* 321°. *Lat.* 16° S.
29. A spot near E. limb.
30. Several small scattered spots. (A return of the fine train, 144.)
31. Very little penumbra.
Aug.
1. One spot much larger, with double nucleus.
2. The two nuclei nearly equal; penumbra S. f. small in proportion.
3. More normal, nucleus still double.
4. Larger, almost circular, diameter 30″; nuclei nearly vertical; one small spot close to edge of penumbra.
5. Penumbra opening to the N. A few small spots in advance (Pereira).
6. No opening in penumbra, nuclei turning more E.
7. Nuclei inclining to the equator, more linear; later in the day curved. (There are now three double spots visible, with penumbra opening in different directions.)
8. Broken up on the f. side.
9. Very much reduced, one small spot with two nuclei; penumbra to the N.
10. Very near W. limb, the two nuclei just perceptible.

July. GROUP 166. *Long.* 315° to 303°. *Lat.* 13° to 16° S.
31. A spot near E. limb, with penumbra on the p. side; nucleus divided.
Aug.
1. More normal, nucleus double.
2. Split into two nearly equal parts.
3. Closer together; f. spots increasing. (Instance of attraction.)
4. Penumbra just in contact to the S. A stream f.; only one spot with penumbra.
5. Still more in contact to the S.; both spots nearly circular; f. spots larger, no longer in a stream.
6. Again more separated, major axis of each nearly 30″. One of the f. spots in length 40″, tapering, the rest smaller.
7. Little change, the f. spot in two parts; more small ones, wispy.
8. Decreasing, rather further apart; f. spot single, only two small ones.
9. Again in contact to the S.; the f. more vertical.
10. Smaller, the f. a tiny pair.
11. No details.
12. Near W. limb.

July. GROUP 167. *Long.* 322°. *Lat.* 6° S.?
30. A very small spot not far from E. limb.
31. Two faint spots, widely separated.

July. GROUP 168. *Long.* 322°. *Lat.* 10° N.
30 A penumbral spot near E. limb.
31. Nearly normal, nucleus in three divisions.
Aug.
1. Nucleus undivided?
2. Nearly circular.
3. Little change.
4. Nucleus breaking up at the extremity.
5. Inclined to the equator; major axis about 40″.
6. More elongated, nucleus bridged over in several places.
7. Nucleus more entire.
8. Smaller, nucleus double.
9. Decreasing.
10. Very small.



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Aug. GROUP 169. *Long.* 300° to 288°. *Lat.* 13° to 20° S.

2. At 8 a.m. a very inconspicuous spot with slight penumbra; at 5.45 a miniature vertical stream of dots had appeared to the S. N.B.—Prof. Pereira was able to observe the sun on August 1, and reports that the position was marked by faculæ; it is, therefore, evident that we have witnessed the first outburst of this group, afterwards so remarkable.
3. Immense increase; in place of the dots a normal elongated spot; many smaller ones f.
4. 9 a.m., the leading spot 1′ of arc in length; as many as seven or eight with penumbra, f.; of these the four last are in a vertical row, with one-sided penumbra. At 5.45 p.m., Prof. Pereira found the four spots in contact, forming a complete zigzag, with dense nuclei and penumbra on the f. side.
5. The group now consists of two huge spots, nearly equal in area, the p. A. with the nucleus in the form of a scorpion, a proboscis-like feeler in front and a tail-like appendage behind, penumbra enclosing the whole, except a space in the fork of the large nucleus, which is filled with faculous light. The f. B. curves to the S., the four nuclei being still conspicuous, the upper ones in the form of a cross; penumbra embracing the whole. By 4 p.m. further changes had taken place, nucleus of A. increasing, rounded in front, the proboscis broken off, B. with the nuclei more consolidated.
6. A. with nucleus more circular, in form helical, the tail-like appendage separate, forming a narrow isthmus between A. and B. The latter with three large nuclei, one very angular, more penumbral shreds to the S., none to the N.
7. A. with pitcher-shaped nucleus, small tassel-like nuclei depending. B. more disjointed, the two largest nuclei wing-shaped, the rest more fragmentary; penumbra spreading between the two large spots but with more lagunes; being nearly on the meridian, it is now seen to its full extent. Area 9,000 square seconds.
8. 8.30 a.m. The large nucleus of A. very dense, oblong, and more vertical, the penumbra is less disconnected between the two spots, and might now belong to either, but is becoming more pointed at the edges and more severed longitudinally. B. has fewer small nuclei, the two largest are close together. At 6 p.m. the nucleus of A. is triangular and fimbriated; this is also the case with the largest nucleus of B. The penumbra appears to have widened in the f. part of the group.
9. Nucleus of A. still larger, but squarer, the interlacing penumbra between the spots is decidedly thinned. B. is rather changing, the lesser nuclei decreased in number.
10. "A division into three great round spots is manifest"; there are patches of detached penumbra in the middle.
11. Only glimpsed. Nucleus of A. still very large, those of B. more broken up.
12. Nearing W. limb; in three sections, the second almost entirely penumbral, the third in two divisions N. and S. with three principal nuclei in each.
13. First section close to W. limb, second a mere line of penumbra; third, still more severed, with penumbra chiefly to the N. and S. of the nuclei.

Aug. GROUP 170. *Long.* 300° to 289°. *Lat.* 13° to 16° N. (on the 6th).

2. A very small spot in a patch of faculæ.
3. Many small spots.
4. The p. spot singular in form, half-moon shaped. Some irregular spots at a little distance E.
5. 7.45 to 9.30 a.m. a train, somewhat zigzag, four of the spots with penumbra on one side only, and small beaded nuclei. At 4 p.m. all larger, very compound, first spot nearly circular, second increasing rapidly, with dense cel-shaped nucleus and penumbra chiefly to the S., last spot with a handle-like appendage, nuclei separating, intermediate spots also increased.



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Aug. GROUP 170—*continued.*

6. 7.45 a.m. Many changes, first spot pointed, second approaching it, divided at the end, making three p. spots, each curved in a different direction, the last more normal, with the appendage gone. The nuclei subdivided and coiled like a helix, intermediate spots with tiny nuclei linked together in a double stream.
7. 8 a.m. Nearly on the meridian, train elongated. The three p. spots at equal distances, more in a line, the first and third nearly equal in area, intermediates separate and individually larger, last spot consolidating. At 3.45 p.m., changes still in progress. Spots more angular.
8. 8.30 a.m. Train lengthened out. The first three spots joined together in a curve, whole length 1′ 40″. The second forming a sort of isthmus. The third has a gap in the penumbra close to the umbra, last spot ear-shaped, intermediates dwindling and dispersing. At 6.15 p.m., the third has become more vertical, bringing the three still closer to each other.
9. Train, instead of being in a straight line, bending towards the equator, intermediates more in number, last spot almost normal but pointed in front with dots issuing from it.
10. First three spots completely united, save a space in the centre with only two nuclei inclined opposite ways, intermediates more trailing and connected, last spot kite-shaped with fimbriated nucleus.
11. Only glimpsed, intermediates disappearing.
12. Nearing W. limb, spots in four sets, the first very large, smaller spots gone, the last trifid, much reduced.
13. At 8 a.m. only two spots visible, the last a diminutive pair.

Aug. GROUP 171. *Long.* 312° to 296° *Lat* 4° to 5° S.

3. A few very small spots.
4. One much larger, narrow, nucleus spindle-shaped, vertical. Smaller spots and dots following in a quadrangular form.
5. Two considerable spots, the p. nearly normal, the f. (at 9.30 a.m.) a crescent consisting chiefly of dots, at 4 p.m., the nuclei expanded, penumbra on the f. side. To the N. some sputterings forming a kind of top-knot.
6. P. tapering, broken at the end, length 30″. The f. no longer a crescent but a miniature stream, a few sharp dots to the S.
7. P. with triangular nucleus and two small ones at the edge of the penumbra, apparently outliers attracted to it. Miniature stream led by a circular spot, more dots to the S., some intermediates.
8. P. more circular, nucleus large, those on the edge of penumbra probably drawn into it. About five separate spots follow in a line.
9. P. with still less penumbra on the f. side. The others much reduced.
10. P. much smaller, still one-sided; only three tiny spots f.
11. Not seen.
12. One small faint spot near W. limb.

Aug. GROUP 172. *Long.* 246°. *Lat.* 17° N.

5. A nearly normal spot, not far from E. limb.
6. Penumbra wider on the p. side.
7. Nucleus round, a small one to the S., penumbra splitting on the p. side.
8. Small nucleus splintered.
9. A portion to the S. severed.
10. A trefoil with three principal nuclei.
11. Still three-lobed.
12. The three lobes, if identical, widely separated, one much diminished.
13. The most p. with double nucleus, the two f. chiefly dots.
14. A zigzag of small spots without penumbra.
15. Much reduced, only half the number.



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Aug. GROUP 173. *Long.* 242° to 238°. *Lat.* 9° to 12° S.

5. A small faint spot near E. limb.
6. A pair.
7. No increase.
8. A little larger, two followers.
9. An open cluster of about seven spots, all small.
10. A semi-ellipse, three p. spots larger.
11. No details.
12. Leading spot increased, one-sided, a few stragglers all that remain of the ellipse.
13. Leader circular, with two nuclei, diameter about 20″, a trio of dots only f.
14. One spot, nucleus irregular.
15. Penumbra only on the f. side.
16. Near W. limb, small and faint.

Aug. GROUP 174. *Long.* 243° to 231°. *Lat.* 4° to 5° N.

6. An insignificant spot near E. limb.
7. Two nuclei, two spots f. at some distance, the larger with two nuclei and penumbra on the f. side.
8. P. with several nuclei and a few outliers, the two f. small pairs.
9. P. reduced to dots, outliers more compact, one small pair f.
10. One diminutive faint spot.

Aug. GROUP 175. *Long.* 228° to 221°. *Lat.* 16° N.

7. Two normal spots (which must have appeared on the 6th), inclined at different angles.
8. The first with crescent-shaped nucleus, penumbra on the p. side. The second becoming fragmentary.
9. Both more normal, tapering.
10. A stream, the leader only with penumbra, major axis 30″, the rest very small.
11. Two principal spots.
12. Spots in three sets, the first circular, the second a pair, the third a diffuse miniature cluster.
13. The first with nucleus large in proportion to the penumbra, pair dwindling, third set gone.
14. The pair much reduced, closer to the first spot.
15. First spot more procumbent, nucleus double, pair only just visible.
16. Decreasing.
17. Still smaller, nearing W. limb.

Aug. GROUP 176. *Long.* 213°. *Lat.* 16° to 17° S.

7. A large spot near E. limb.
8. Nearly normal, bulging eastward, nucleus with a light patch close to it in the same direction, faint outliers f.
9. A process to the E. side of nucleus.
10. Nucleus oblong, angular, bridged, outliers increasing, forming a chain to the S.
11. One outlier larger than the rest.
12. Nucleus entire, outliers separate, one just touching main spot, with two small nuclei. One apparently with penumbra only, another a mass of dots. Area 2,000 square seconds.
13. More vertical, turning away from the equator, outliers almost gone, except the one in contact.
14. Somewhat quadrangular, the outlier absorbed, leaving a small nucleus on the margin of the penumbra.
15. Penumbra rent in two places, nucleus fimbriated to the S.
16. Nucleus tapering, sinuous, penumbra ragged, three small patches as if torn off, two to the S. one to the N.
17. Split in two latitudinally, the lower part with three nuclei, the upper hooked at the end with small nuclei detached from the larger one; the penumbral patches to the S. only left, smaller, more like dots.



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Aug. GROUP 176—*continued.*

18. Nearing W. limb, having the appearance of one large spot much broken up to the N. and S., with many nuclear fragments; penumbra chiefly on the p. side.
19. Extremely reduced, unless the spot observed is only a follower (9 a.m.).

Aug. GROUP 177. *Long.* 206° to 200°. *Lat.* 18° N.

9. Two or three very small spots, hardly more than dots, widely separated.
10. Two nebulous spots surrounded with faculæ.
11. Three spots.
12. Two spots, one smaller.
13. Not seen.
14. Three little spots, nearer together.
15. One, nucleus double.

Aug. GROUP 178. *Long.* 262° to 258°. *Lat.* 28° to 30° S.

11. Four irregular spots of delicate texture made up chiefly of dots interspersed with a few pointed nuclei and a little penumbra.
12. Two spots, no details.
13. Two compound spots, the p. trifoliate, fragmentary, the f. smaller but more regular.
14. The p. with penumbra to the N., the f more to the S., many scattered fragments.
15. Spots fewer and smaller.

Aug. GROUP 179. *Long.* 170° to 164°. *Lat.* 9° to 12° N.

12. A very small faint spot at some distance from E. limb.
13. Little change. (This group proved one of much interest though the spots were small at first.)
14. A trifle larger, a similar one S. f. at a distance.
15. More in number, but little increase in area. F. spot gone.
16. A stream, spots dark and sharp, without penumbra, following each other in a straight line, a little expanded at the end.
17. Only a few of the first and last remaining, one of the leaders increasing at 6 p.m.
18. 7.30 a.m. Leader a compound, intricate, one-sided spot, penumbra to the S. The f. spots chiefly sharp dots, widely diffused, and almost elliptical, with a tendency to miniature streams.
19. Leader becoming more regular, five nuclei, three of the followers concentrated, one a trefoil, two in the shape of larvæ, with beaded nuclei.
20. Two principal spots some distance apart, one with several nuclei, and penumbra all round, the other with penumbra to the N. and fragments to the S., hardly any intermediate spots.
21. The p. normal, the f. more regular.
22. One spot only visible near W. limb at 9.15 a.m.

Aug. GROUP 180. *Long.* 146°. *Lat.* 23° N.

13. A small nebulous spot, not far from E. limb.
14. Nucleus double, two outliers.
15. Three very small spots close together.
16. Positions altered.

Aug. GROUP 181. *Long.* 120°. *Lat.* 11° S.

14. A considerable spot, near E. limb at 9.15 a.m.
15. Two nuclei with light round them. Two small spots f.
16. Three nuclei, one of the f. spots, with nucleus, just in contact; a few smaller ones more distant.
17. Cleft in three places, nuclei also sub-divided, four little spots f.
18. Tapering in the opposite direction, nuclei altered in form and position, a portion of the f. quite severed.
19. More elongated, nuclei in an ellipse, severed portions with two nuclei, a tail-like sinuous stream of faint spots f.



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Aug. GROUP 181—*continued.*

20. No important change.
21. Nuclei consolidated in front, much attenuated at the rear, tail-like stream almost gone.
22. Decreasing.
23. Pear-shaped.
24. More angular, nucleus broken up.
25. Very small.

Aug. GROUP 182. *Long.* 104°. *Lat.* 12° S.

16. A spot following 181, and nearly equal in area, with three nuclei and penumbra only on the f. side.
17. Two nuclei, penumbra more equalised, but splitting between the nuclei. N.B.—There are now four spots very much resembling each other, three of them with nearly the same latitude.
18. More normal, nuclei in a quatrefoil, with light in the centre, some dots half way between this and the f. spot (secondary train).
19. Pear-shaped, nucleus entire, two very small followers.
20. A few more followers.
21. On the meridian, oval, inclined to the equator.
22. Tapering at the end, a sprinkling of small spots p.
23. Tapering in front, major axis 40″. More outliers to the S., later four in a row.
24. More circular, outliers scattered.
25. Quite normal, outliers fewer.
26. Nearing W. limb, outliers nearly gone.

Aug. GROUP 183. *Long.* 110° to 94°. *Lat.* 18° to 27° S.

16. Three faint spots near E. limb.
17. A considerable spot, evidently two of the faint ones united.
18. Spot with three nuclei, pointed, split on the N. f. side into four fan-like sections, more spots f., three in a close triangle, some misty dots.
19. Much widened out, winged on either side, nuclei increasing, f. spots forming a secondary train.
20. Two principal nuclei, secondary train with some penumbral spots.
21. Main spot divided into several distinct ones, secondary train extending eastward.
22. One spot, oval, with a tail-like appendage, the others very fragmentary.
23. At 7.30 a.m. spots closing round in a pentagon, with penumbra pointing outwards. At 4.30 p.m. closer together in a circle, some of the nuclei uniting, only the f. spots of the secondary train left.
24. One double ear-shaped spot, a smaller penumbral one opposite, and two dots.
25. One-half only of the ear-shaped spot left and two penumbral patches.
26. A very small splintered spot in the midst of faculæ.

Aug. GROUP 184. *Long.* 85° to 88°. *Lat.* 11° S.

17. A regular spot showing signs of cleavage.
18. Nucleus in the form of a horse-shoe, a portion to the S. quite severed.
19. Elongated, tapering in the opposite direction, nucleus more regular.
20. Small spots f.
21. Oblong, one f. spot larger.
22. Normal, two small followers.
23. Nucleus large, circular, major axis 40″.
24. Nucleus pointed at the extremity.
25. Much foreshortened, penumbra equal on both sides.
26. Nucleus cleft centrally.
28. Near W. limb, a portion to the S. detached.

Aug. GROUP 185. *Long.* 88°. *Lat.* 10° N.

17. A small circular spot.
18. Nebulous, faculæ f. A smaller spot near E. limb with bright faculæ.
19. No increase.
20. Still visible.
21. Very small.



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Aug. GROUP 186. *Long.* 106°. *Lat.* 28° S.
18. A new group, three days from centre of disk. A leading spot nearly normal, length 20″. Small spots f. in three sets at right angles to it.
19. Leader with three nuclei, penumbra only to the N. Two of the f. spots increased.
20. F. spots altered in position.
21. Leader normal, f. spots smaller, following in a scattered stream.
22. Leader circular, f. spots more in a cluster, with a patch of penumbra in the midst of them.
23. Leader breaking up, with small nuclei in the form of a horse-shoe, only a few dots f.
24. Closed up, with two nuclei.
25. More tapering.
26. Very small.

Aug. GROUP 187. *Long.* 172° to 168°. *Lat.* 12° S.
19. A very few small spots, two of them pairs, past the centre of disk.
20. One spot larger.
21. A double spot and a small pair to the N.

Aug. GROUP 188. *Long.* 70° to 63°. *Lat.* 9° to 12° N.
19. A few very faint spots not far from E. limb.
20. Increasing, more than double the number.
21. Three spots in a line, the last showing rapid growth in a few hours.
22. A singular train of many small but dense spots, expanding in front.
23. Two of the spots increased, the rest very small.
24. One leading spot larger and nearly normal, length 20″.
25. Two leading spots, only dots f., but sparsely scattered, extending as far as Group 189.
26. Fast decreasing, only four spots visible.

Aug. GROUP 189. *Long.* 52° to 48°. *Lat.* 8° to 9° N.
20. Two nuclear spots f. Group 188.
21. Litte change.
22. A compact little stream of four or five spots, close together, with slight penumbra.
23. Two separate spots, the first with double nucleus, the second smaller, each accompanied by a few dots.
24. P. spot circular, with several nuclei, f. breaking up.
25. Oval, three nuclei, f. much smaller.
26. Again circular, nucleus entire, f. still smaller.
27. P. with angular nucleus, f. almost gone, a small spot f. about 12° distant.
29. Little change, penumbra on the side nearest limb.
30. Decreasing.

Aug. GROUP 190. *Long.* 140° to 137°. *Lat.* 17° N.
21. A few very small spots f. Group 179 at some distance.
22. Two somewhat nebulous spots.
23. Two considerable spots, the p. with three nuclei, the f. divided.
24. Both smaller but more regular.
25. Very near W. limb at 7.30 a.m.

Aug. GROUP 191. *Long.* 40°. *Lat.* 17° N.
21. A few little spots N. following Group 189.
22. In two sets, surrounded with faculæ.
23. Two spots with slight penumbra.
24. P. normal, length not more than 20″, f. fragmentary.
25. One spot with two nuclei.
26. Decreasing.
28. Small and nebulous.
29. Very small.



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Aug. GROUP 192. *Long.* 18° to 11°. *Lat.* 26° N.
23. An insignificant spot not far from E. limb.
24. A little stream, spots all small.
25. At 7.30 a.m. a compound double spot, major axis 45″. At 5.20 p.m. more entire, with five nuclei, curling round at the extremity. (A sinuous stream of small spots f.)
26. Expanding, three nuclei, the f. stream in two parallel lines.
28. Cloven, more equatorial, streams with more spots closer together, following it a rapidly developed double spot, penumbra to the N. A new penumbral spot about 12° S. f.
29. Larger and more normal.
30. Nearly circular, nuclei in a trefoil.
31. Elongated. Two or three small spots N. f.

Sept.
1.
2. Dwindling.
3. Still smaller.

Aug. GROUP 192*. *Long.* 41°. *Lat.* 17° N.
25. A sinuous stream of small spots f. Group 192.
26. In two parallel lines.
27.
28. More spots, closer together, the most f. larger than the rest, double.
29. A star-shaped cluster of dots only remaining.
30. A few spots in a triangle.

Aug. GROUP 193. *Long.* 305° to 301°. *Lat.* 12° to 16° N.
28. A very large normal spot; at 9.30 about 24 hours from E. limb.
29. Nucleus fimbriated.
30. Nucleus fish-tailed at the extremity.
31. Pear-shaped.

Sept.
1. Small outliers N. f.
2. Nearly central, inclined to the equator, tapering, length 1′ 23″, breadth 1′ 6″.
3. Little change.
4. Less tapering, but with a point at the end.
5. Nucleus jagged on the f. side.
6. A few outliers still N. f.
7. Nucleus divided near W. limb.

Aug. GROUP 194. *Long.* 307° to 296°. *Lat.* 10° to 14° S.
28. Several small spots near E. limb, followed by a larger one with two nuclei.
29. Two spots, the p. A. with three nuclei; the f. B. almost normal, a little stream of dots between.
30. A. with one nucleus very large, cloven; B. with a penumbral arm singularly protracted in front, and toothed like the bones of a fish, only a few faint nuclei perceptible in it.
31. A. pear-shaped. B. with the p. penumbra less toothed, spreading out towards the N. like a wing, with more incipient nuclei, the main spot pointed in front, many small outliers between the two.

Sept.
1. A. breaking up at the extremity. B. with the penumbra entirely disconnected from the main spot.
2. No longer two separate spots, but a train, 15° in length, the first and last still larger than the rest, nearly central.
3. Individual spots separating, A. very large, forked, with penumbral arms streaming from the extremity. B. normal.
4. Train serpentine. A. with divided nucleus. B. more circular, intermediate spots more distinct, with small nuclei following each other like the links in a chain.
5. A. with two distinct nuclei. B. more vertical.



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Sept. GROUP 194—*continued.*

6. Train resolving itself once more into two principal sections. B. decreasing.
7. A. more broken up. B. with two nuclei, fewer and more separated.
8. Nearing W. limb.
9. One spot only visible at 8.30 a.m.

Aug. GROUP 195. *Long.* 294° to 288°. *Lat.* 17° to 21° S.

28. A large spot near E. limb at 9.15.
29. Nearly normal.
30. A projection on the f. side, containing two small nuclei and penumbral patches.
31. More vertical, f. portion almost disconnected from the main.

Sept.

1. Nucleus more divided; f. portion increasing.
2. Nuclei sinuous, f. portion with two penumbral wing-like appendages.
3. Nuclei containing as many as seven sections, and prolonged equatorially. At 9.30 the penumbral wings dispersed. At 4 p.m. fewer sections, and more dispersion at the rear.
4. Signs of general dismemberment.
5. No important change.
6. The p. portion nearly dissevered from the rear, which consists of small nuclear spots.
7. Still elongated, in many sections.
8. Nearing W. limb, but apparently decreasing.
9. Diminishing, with fewer sections. (Invisible at 8 a.m. on the 10th.)

Aug. GROUP 196. *Long* 262° to 254°. *Lat.* 13° to 15° S.

31. A small but normal spot near E. limb.

Sept.

1. Some lesser spots f.
2. Three spots.
3. Leader with pear-shaped nucleus.
4. Nucleus bridged; f. spots very small.
5. Several bridges, followers increased.
6. Three principal spots.
7. No increase.
8. Three small spots nearer together.

Sept. GROUP 197. *Long.* 320°. *Lat.* 5° S.

4. A wide pair of small spots less than one-third of sun's radius from W. limb.

Sept. GROUP 198. *Long.* 220°. *Lat.* 8° S.

4. A few very small spots not far from E. limb.
5. More numerous, three with penumbra.
6. Leading spot much larger. (Area of group 1,250 square seconds.)
7. Still increasing, many smaller f. (area 1,600 square seconds.)
8. Leader nearly normal, a train f.
9. Leader more than 1′ of arc, major axis, nucleus crescent-shaped in front, only attached at the cusps to the f. part, leaving a gap in the penumbra; five penumbral spots f., with dots interspersed.
10. At 8 a.m. the whole of the nucleus crescented, some of the f. spots pointing vertically. At 5.30 p.m. nucleus in two portions, an adjacent spot in contact, chiefly composed of penumbra, with the leader at two points.
11. At 9.15 a.m. adjacent spot in contact only at one point. Nuclei in four divisions, f. train much altered and diminished.
12. Adjacent spot quite detached, penumbra on the f. side.
13. Penumbra on the p. side, more broken up, f. spots reduced to three or four, quite small.
14. Near W. limb, upper portion and adjacent spot much reduced, no f. spots seen.



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Sept. GROUP 199. *Long.* 278°. *Lat.* 18° S.
6. Two or three small spots, f. Group 195.
7. Four spots.
8. One spot.

Sept. GROUP 200. *Long.* 247° to 244°. *Lat.* 22° S.
6. A small spot to the E. of the centre of disk.
7. Two spots.

Sept. GROUP 201. *Long.* 170°. *Lat.* 9° S.
8. Some penumbral spots very near E. limb.
9. Apparently four spots united, with a singularly undulating outline. A small spot f. at some distance.
10. The four spots broken up into a train of lesser ones. The p. much larger than the rest.
11. The p. a double spot, dividing into two equal parts, only connected in the centre. The f. fewer, very widely separated.
12. The p. consisting of two nearly normal spots, only connected by penumbra to the S. Whole length 1′ 30″.
13. Re-united, the larger nucleus circular, only one f. spot with penumbra, the rest dots or splashes.
14. Severance again taking place. The Rev. F. J. Eld, with an 8½-in. reflector, observed at 10.30 a.m. a remarkable ring of intense whiteness, circular in form, and extending over one-third of a circle at the f. part, where the spots were previously united. It seemed brighter than the photosphere generally, and almost like bright bridges when seen projected across the surface of umbræ, there being in this case only the penumbra to afford a contrast. Professor Pereira saw this curve (from 9.18 to 10.23 a.m.), but in his drawing it is less extended. Miss E. Brown observed a decided division (7.40 to 8.5), but not any curvature or remarkable brightness.
15. Spots reunited, excepting a small space between the two, centrally, which still preserved its brightness. F. spots very few and small.
16. Once more dividing, the p. larger than the f. spot, a stream of dots at the rear.
17. Two distinct spots, the f. more diminished, a few small outliers.
18. Nearing W. limb. Outliers rather increased. Only faculæ at 6 p.m. of the 19th.

Sept. GROUP 202°. *Long.* 218°. *Lat.* 13° N.
8. A few small spots near the centre of disk.
9. One nebulous spot.
10. Two little pairs.
11. Decreasing, some dots to the S.
12. Again two pairs.

Sept. GROUP 203. *Long.* 133°. *Lat.* 8° N.
10. Four or five little spots close together, many faculæ f.
11. One spot increased.
12. One spot only, not more than 20″ in length.
13. Divided centrally.
14. Reunited, a miniature stream f.
15. Three nuclei, decreasing.
16. Little change.
17. Almost gone.

Sept. GROUP 204. *Long.* 113°. *Lat.* 22° S.
11. A penumbral spot near E. limb.
12. Penumbra on f. side.
13. Penumbra nearly equal, two nuclei.



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Sept. GROUP 204—*continued.*
14. Nuclei more in number.
15. Little change, a few dots f. (Major axis 25″.)
16. Two distinct nuclei, an appendage of dots.
17. Decreasing, nebulous.
18. A few dots f. and five at some distance p.
19. Faint. No distinction between umbra and penumbra.
20. Little change.

Sept. GROUP 205. *Long.* 108°. *Lat.* 20° S.
12. A small spot near E. limb, probably the remains of Group 186.
13. Penumbra only on the p. side.
14. Three very small spots.
15. One spot.

Sept. GROUP 206. *Long.* 197°. *Lat.* 2° N.
13. A small spot in the f. hemisphere.
14. Nebulous.

Sept. GROUP 207. *Long.* 182°. *Lat.* 9° N.
13. A little spot with two nuclei and penumbra on the f. side only.
14. Much diminished, nebulous.

Sept. GROUP 208. *Long.* 141°. *Lat.* 32° N.
15. A very faint spot, unusually far N.

Sept. GROUP 209. *Long.* 62° to 59°. *Lat.* 5° to 9° N.
15. A large spot near E. limb (at 7.40 a.m.) with five nuclei, penumbra wider on the f. side.
16. Very compound. Three principal nuclei. At 9 a.m. Prof. Pereira observed four small nuclei on the f. edge of the penumbra.
17. Principal nuclei more in number, but smaller; major axis 1′ 20″.
18. Full of detail, nuclei "invaded by veils."
19. Five nuclei. Some of them again sub-divided, a striking feature in this spot, considering the uniformity of the general outline.
20. Still more sub-division in the nuclei, a narrow fissure at the extremity, penumbra more indented.
21. Signs of breaking up to the N. A small fragment of penumbra detached.
22. One nucleus much enlarged, some still pointed. More semi-detached penumbra to the N. Radiations in p. portion distinctly seen, though definition poor.
23. Largest nucleus jagged, spot curved in outline, detached penumbra disappearing.
24. More broken up both as to the nuclei and penumbra.
25. Become an ill-defined group of three.
26. Near W. limb, decreasing.
27. Very near W. limb.

Sept. GROUP 209*. *Long.* 55° to 48°. *Lat.* 12° N.
21. Some very small spots very widely scattered, three of them pairs, f. Group 209.
22. A stream hardly more than dots in five sets. Position not the same as those observed yesterday.
23. Many more spots in a zigzag, the last larger than the rest, penumbræ slight.
24. Spots coalescing and forming four of larger size.
25. Decreasing, in two sets, the f. with new ones in addition.
26. Fewer.
27. Near W. limb, one spot larger.



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Sept. GROUP 210. *Long.* 50°. *Lat.* 7° to 8° S.
17. Two or three small spots not far from E. limb.
18. One spot much increased, with several nuclei in a curved line.
19. Pear-shaped, a few spots f.
20. Normal.
21. F. spots in a triangle.
22. Nearly circular.
23. Nucleus sinuous, one f. spot.
24. Nucleus nodular.
25. Normal.
26. Little change.
27. Much foreshortened.

Sept. GROUP 211. *Long.* 76°. *Lat.* 25° N.
19. Two or three small spots widely separated.
20. Decreasing.

Sept. GROUP 212. *Long.* 30° to 25°. *Lat.* 25° S.
20. A few small spots not very near E. limb.
21. Two spots more widely separated.
22. Little change.
23. One spot with a little penumbra.

Sept. GROUP 213. *Long.* 111°. *Lat.* 42° N.
21. A small spot with slight penumbra, with a still smaller one to the S. at some distance from W. limb. (Observed by Prof. Pereira, who also noticed four black dots at 10.28.)
22. Somewhat diminished, no smaller spot, faculæ S. f. On the following day, the 23rd, at 11, a bright facula of peculiar shape, like two arms at right angles to each other was observed by the Rev. F. J. Eld. Possibly indicating two spots.

Sept. GROUP 214. *Long.* 352°. *Lat.* 10° S.
21. A few very insignificant dots near E. limb.
22. Rather more.
23. One ill-defined spot.
24. Another very similar spot f.
25. Decreasing.

Sept. GROUP 215. *Long.* 339°. *Lat* 5° to 12° S.
22. Small scattered spots f. Group 214, each encompassed with faculæ.
23. Two small spots, and one much further S.
24. The spots to the N. more numerous, but still very small. Three to the S.
25. Spots to the N. in two sets, the most p. a miniature cluster, one only S.
26. Decreasing, positions altered.
27. Dots only, wide apart, in two streams, several of them in pairs.

Sept. GROUP 216. *Long.* 42°. *Lat.* 20° N.
23. A very small spot f. Group 209*.
24. A pair of penumbral spots f. each other.
25. Little change.
26. The f. much decreased.

Sept. GROUP 217. *Long.* 301°. *Lat.* 10° to 16° N.
23. A small penumbral spot near E. limb at 11.30. (A return of Group 193.)
24. Penumbra nearly equal on both sides. A smaller spot p.
25. Normal.
26. Little change.
27. Major axis 1′ of arc, small p. spot about 15″.
28. Nucleus not uniform in tint, darker centrally. The p. half-moon shaped, a portion of the nucleus detached.
29. Dark pupil of nucleus still visible, a rusty tint to the end of it.
30. Pupil of nucleus oblong, penumbra furrowed by ravines, dots and small spots circling round. P. spot dwindling.



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Oct. GROUP 217—*continued.*

1. Nucleus and penumbra more fimbriated. Outliers chiefly dots, some of them in tiny streams.
2. Outliers nearly gone.
3. Two tiny streams of dots only, N. f.
4. Still nearly normal. New outliers in an irregular stream to the N.
5. No outliers seen.
6. Near W. limb at 1.25. Penumbra wider on the p. side. (Rotation less than 13 days.)

Sept. GROUP 218. *Long* 306°. *Lat* 11° S.

24. A penumbral spot with two nuclei; must have appeared on the 23rd.
25. No details.
26. One or two very small spots f. at some distance in the same position as the large August group.
27. Three nuclei.
28. Nearly circular, largest nucleus indented. A few dots f.
29. Nucleus undivided, three outliers.
30. Nucleus trifid, a miniature stream f. at a little distance.

Oct.

1. Little change.
2. Nucleus entire.
3. Penumbra on the p. side; two small spots f., one of them distant.
4. Little change.
5. Near W. limb; decreasing. (Rotation 12 days.)

Sept. GROUP 219. *Lony.* 327° to 318°. *Lat.* 6° to 9° N.

27. About six little spots in the form of a triangle, nearly two days E. of the centre of disk.
28. An angular spot p., a stream of dots f.
29. Great increase, the angular spot doubled in area, almost square, the nucleus sharply pointed at the corners, and a vacancy in the centre; a branch of penumbra to the N., connecting some irregular outliers and stretching out towards the f. spot, which has developed from the dots of yesterday, and somewhat resembles an hour-glass, and contains many small nuclei.
30. P. spot with the nucleus bridged and curving towards the E., outliers to the N. more separated. The f. spot splitting up.

Oct.

1. P. with the nucleus curling round westward and a horn to the N., outliers still more separated; f. spot half-moon shaped, also curving westward.
2. Nucleus of p. with a double curve, penumbra even; one outlier more in advance, others again amalgamating; f. spot more angular.
3. Group almost zigzag, four principal divisions, but still a great amount of detail.
4. Near W. limb in three principal sections.
5. The last spot close to W. limb at 1.3C.

Sept. GROUP 220. *Long.* 278°. *Lat.* 10° S.

30. A pair of spots followed by a triplet, more than half the sun's radius from centre of disk.

Oct.

1. About five spots in a stream.
2. No increase.
3. A few dots.

Oct. GROUP 220*. *Long.* 227°. to 221° *Lat.* 21° S.

3. Two sets of dots widely separated.
4. The p. more in a stream.
5. Three spots in a triangle, with slight penumbra.
6. One much increased, normal and circular.
7. Rapidly diminishing, only one spot.
8. Little change.
9. Still smaller.



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Sept. GROUP 221. *Long.* 233°. *Lat.* 3° N.
29. A penumbral spot near E. limb.
30. Normal, a few followers.
Oct.
1. One f. spot increased.
2. Nucleus divided, f. spots smaller.
3. Four nuclei.
4. Five nuclei.
5. Cloven to the N.; each portion with two nuclei.
6. Distinctly separated.
7. One spot of the pair decreasing rapidly, the other in the form of a horse-shoe.
8. The smaller spot still dwindling, with no penumbra.
9. Smaller spot increased.
10. Three very small spots near W. limb.

Oct. GROUP 222. *Long.* 211°. *Lat.* 21° S.
1. A small spot in the midst of faculæ.
2. Three spots with very slight penumbra.

Oct. GROUP 223. *Long.* 175°. *Lat.* 8° S.
3. A spot very near E. limb at 1 p.m. (a return of Group 211).
4. Penumbra about equal on both sides.
5. Nucleus divided.
6. Nucleus entire. Two faint spots some distance p.
7. Nucleus again dividing.
8. Nucleus oblong, entire.
9. Almost circular.
10. Two nuclei.
11. Little change.
12. More oval.

Oct. GROUP 224. *Long.* 197° to 189°. *Lat.* 15° N.
5. A pair of somewhat angular spots, some distance apart.
6. Four spots more widely separated.
7. Two, the p. single, the f. with a few dots.
8. One, nebulous.
9. A wide pair, faint.

Oct. GROUP 225. *Long.* 155°. *Lat.* 13° S.
6. Three small spots f. Group 123, and one much in advance.
7. Penumbra slight.
8. The two f. larger, almost a pair.
9. Two, decreasing.
10. The p. spots very small.
11. Little change.
12. One spot p. a tiny cloud of dots f. (Position of principal spot as above.)
13. Penumbra only to the N.
14. Dwindling.
15. Two spots.

Oct. GROUP 226. *Long.* 139°. *Lat.* 16° S.
7. A train of irregular spots not far from E. limb.
8. A zigzag, two of the spots with penumbra and very similar.
9. More in a line.
10. Two of the spots nearly normal, more outliers.
11. No radical change.
12. One spot normal, outliers nearly gone.
13. Circular.
14. Outliers again more numerous.



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Oct. GROUP 227. *Long.* 87°. *Lat.* 19° S.
12. Three very small spots several days from E. limb.
13. Two spots.
14. Still smaller, a new one f. at a distance.
15. Not seen.
16. Not seen.
17. The distant spot visible.
18. A penumbral spot p., with a few small followers.
19. One spot, nearly normal, major axis 20″.
20. Much reduced, a few faint spots f. at some distance.
21. Very small.

Oct. GROUP 228. *Long.* 86°. *Lat.* 23° N.
10. A large spot near E. limb at 10 a.m.
11. Normal.
12. Nucleus double, with a horn-like projection on one side, penumbra nearly equal.
13. Length 1′ of arc.
14. One or two outliers.
15. Nucleus single.
16. Outliers to the N.
17. Little change.
18. Nucleus irregular.
19. Nucleus in three divisions, the middle one long and narrow, and curving upwards between two small ones.
20. Nucleus wedge-shaped, less divided.
21. Nucleus two-lobed, penumbra wider on the p. side.

Oct. GROUP 229. *Long.* 53°. *Lat.* 12° N.
12. A penumbral spot very near E. limb at 1 p.m. preceded by a patch of faculæ.
13. Four spots, the two f. smaller than the two p.
14. The second spot the largest.
15. A train, spots pretty equal in area.
16. One spot much larger, those f. diminutive.
17. Principal spot with two nuclei, and a wing-shaped appendage.
18. Divided centrally, each half with one distinct nucleus; the appendage severed and become a separate spot. The f. few and small.
19. Still in contact to the N. Nuclei altering in form, the f. triangular, whereas on the 18th the p. was triangular, and the f. more curved, all attendant spots decreasing.
20. The f. nucleus with a bridge and fimbriated edges, small spots inclined to form streams.
21. Spot cleft to the S. instead of to the N., nuclei more entire, one outlier only p.
23. An opening to the S. but no separation, nuclei smaller, penumbra on the p. side.
24. Near W. limb, nuclei connected.
25. Much diminished.

Oct. GROUP 230. *Long.* 40°. *Lat.* 15° N.
14. A penumbral spot f., Group 229.
15. No details.
16. Normal.
17. Two nuclei, penumbra on the f. side.
18. Major axis 40″, numerous small spots p.
19. Nuclei in a crescent, a swarm of faint outliers.
20. Less crescented, but still one-sided, fewer outliers.
21. More normal, pear-shaped, two f. spots only.
23. Almost gone.



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Oct. GROUP 231. *Long.* 37°. *Lat.* 14° S.

14. A considerable spot near E. limb.
15. Penumbra on the f. side.
16. Two spots, near each other.
17. The p. normal, nucleus two-lobed, the f. half the size, one-sided.
18. P. with the nucleus bridged, f. much broken up.
19. P. with three nuclei, f. with five in a row, and penumbra only S. f.
20. Nucleus of p. bridged and broken in many places, but penumbra showing little disruption. The f. a mass of fragments.
21. P. with three distinct nuclei, f. rapidly disappearing.
23. Broken up into fragments to the N.
24. A portion to the N. detached.
25. Near W. limb.

Oct. GROUP 232. *Long.* 339°. *Lat.* 6° S.

18. A large spot near E. limb at 1 p.m.
19. Outline wavy, with a narrow segment streaming from the nucleus to the S. A few followers.
20. Nucleus sharply fissured on the p. side, a fragmentary cluster more to the N., an irregular spot f. with penumbra p.
21. A very fine spot, nucleus large and tapering, with three small fragments at the point, the cluster has coagulated, and become a one-sided spot of considerable dimensions.
23. A great change, form entirely altered. Two of the small fragments have separated and become a large leading spot, quite distinct from the main one, which has now two wedge-shaped nuclei pointing in an opposite direction, the one-sided spot is united to it at the N. and S. points of the penumbra, leaving a vacant space between close to the nucleus.
24. Extreme length 2′ of arc, breadth 80″. Leader with the nucleus hollowed out in front, barred at the rear, where it almost touches the main spot, which is very compound, with hooked nuclei, curving towards the f. portion now united to it, and having a dense fimbriated nucleus.
25. The spots appear united. Some change in the shape of the nuclei. (Poor definition.)
26. A separation has again taken place, the leader has the nucleus more divided, the f. is still very large and complicated.
27. Signs of breaking into three, middle spot turning as on a hinge to the N.W., the p. to the S.W., a bridge in the big spot disappeared 10 minutes after being sketched.
28. Beginning of further dismemberment, though no division into three has taken place. P. portion quite severed at 11.30 a.m., and a small spot thrown off in front, the large nucleus less curved.
29. Much foreshortened, nuclei separating and decreasing.
30. Near W. limb.

Oct. GROUP 233. *Long.* 336°. *Lat.* 19° S. (Leader).

18. A considerable spot at nearly the same distance from E. limb as 232.
19. More incipient spots to the N.
20. Leading spot nearly normal; those to the N. a mixture of nuclei and penumbra.
21. Spots forming a curved stream, leader little altered.
23. Leader broken in two lengthwise, a new spot to the N. of it; fewer small followers.
24. Leader with one portion destitute of penumbra. Besides the new northerly spot and one of the f. which has a dense nuclear texture there remains only mere dots.
25. All diminished.
26. Still smaller.
27. One nebulous spot only.
28. Very small.



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Oct. GROUP 234. *Long.* 335° to 330°. *Lat.* 7° to 10° N.

19. Two spots near E. limb.
20. Both compound, the p. much smaller than the f. A few outlying dots.
21. The p. with two nuclei thrown off; the f. split in twain forming a pair.
23 The p. fast failing, the f. re-uniting; a new spot N. p.
24. Decreasing, p. with penumbra only to the S.
25. A train of small spots very scattered.
26. All diminishing.
27. An irregular cluster in the form of a triangle, spots more penumbral than nuclear, and much closer together; many dots.
28. Quite altered in position, scattered, and spreading to the N.
29. Four spots with the penumbra of each on the p. side, nearly equal; few dots left.
30. Only two with penumbra.

Oct. GROUP 235. *Long.* 299°. *Lat.* 12° N.

21. A penumbral spot near E. limb.
23. Normal, nucleus double, a swarm of dots to the S.
24. Nucleus enlarging, dots fewer; a few small spots p.
25. Outliers less numerous.
26. Quite normal.
27. Nearly circular, a small portion of the nucleus detached from the mass.
28. Detached portion larger, nucleus much fimbriated.
29. Entire, no outliers.
30. Nucleus tapering, symptoms of division.
31. Entire, solitary. Visible November 1-2.

Oct. GROUP 236. *Long.* 349°. *Lat.* 24° N.

23. Three very small spots W. of the meridian.
24. More in number, but no increase in area.
25. Little change.
26. Almost gone.

Oct. GROUP 237. *Long.* 290°. *Lat.* 8° S.

23. A pair of small spots. Penumbra on opposite sides. A large spot f. with nucleus jagged on the S. side. Dots widely separated to the S.
24. The pair, each having two nuclei, united to the N. F. spot with penumbra on the p. side.
25. The pairs separated by a space equal to their diameters, penumbra still on opposite sides. F. spot more normal. A few outliers.
26. One of the pair of spots broken up.
27. F. spot 1′ of arc extreme length. Sinuous in outline.
28. Signs of dissolution at the extremities. A row of dots to the N. in a singularly straight line. Some stragglers f. the p. spots. Three new ones have appeared N. f.
29. Narrower, three nuclei, dots gone. P. more normal; two little spots between the two.
30. Dividing centrally. The N. f. spots seem inclined to form two clusters.
31. There are now two spots nearly equal.

Nov.

1. All smaller but more numerous; in a stream tapering to a point.
2. A few very tiny spots in two sets.
3. One spot with three nuclei.
4. One small spot.

Oct. GROUP 238. *Long.* 338°. *Lat.* 19° N.

24. A few small spots not far from the centre of disk.
25. A widely scattered stream.
26. Leading spot much increased, prolonged equatorially.
27. Leader nearly normal, nucleus divided, some of the f. spots forming a tail-like appendage; one more distant.



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Oct. GROUP 238—*continued.*

28. Three nuclei, sinuous ; f. spots quite disconnected.
29. A single spot, much reduced, penumbra S. p.
30. Penumbra on the p. side.

Oct. GROUP 239. *Long.* 320° to 314°. *Lat.* 8° S.

23. A few very small spots on a line with Group 232.
24. No increase.

Oct. GROUP 240. *Long.* 265°. *Lat.* 14° S.

25. A few little spots not far from E. limb.
26. Little change.
27. Leader penumbral.
28. A miniature train ; no spot with penumbra.
29. Spots fewer.

Oct. GROUP 241. *Long.* 186°. *Lat.* 7° S.

30. A small spot near E. limb.
31. Penumbra on the p. side.

Nov.

1. Two nuclei, penumbra, as it were, only outlined on the f. side, a smaller spot to the S., where a faint marking was observed in the midst of faculæ on the 31st.
2. Decreasing, solitary.
3. Little change.
4. Increasing, but broken in two, penumbra on one side opposite the breakage, major axis 25″.
5. In the form of a trefoil.
6. A pair.
7. One attendant.
8. Two nuclei, a very small spot f.

Nov. GROUP 242. *Long.* 179°. *Lat.* 11° S.

1. (A very small spot, about 2 days from E. limb.)

Nov. GROUP 242*. *Long.* 163° to 157°. *Lat.* 14° S.

3. A spot with slight penumbra on the p. side.
4. Three very small spots in two sets.
5. Two clusters containing 14 black nuclei besides many sputterings. (With poor definition appearing like two spots.)
6. With hazy definition, the p. a pair, the f. one small normal spot.
7. Rather more in number.
8. Two sets consisting of tiny nuclei with a little penumbra pointing in opposite directions; dots in two streams between.
9. Decided increase. A leading spot, almost normal, with semi-detached portions at the extremity and dots streaming from them, two distinct spots at the end of the train ; total, 14 black nuclei.
10. Leader with bridged nucleus ; a scattered group of 6 nuclei and sputterings follow.
11. Leader with five nuclei, several detached from the penumbra, which is only on the p. side ; one very fragmentary spot f.
12. Leader with only two nuclei, one detached, three diminutive spots f.
13. Immersed in faculæ, which are distinctly divided into two portions.

Nov. GROUP 243. *Long.* 154°. *Lat.* 5° N.

2. A small spot not far from E. limb.
3. No increase.
4. Almost destitute of penumbra. On this date Prof. Pereira observed a tiny black spot at 10.30. At 11.30 reduced to a dot. No sign of it on the 5th, though good definition.
5. Little change.
6. Little change.
7. Slight penumbra to the E. and W.
8. Three dots.



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Nov. GROUP 244. *Long.* 143°. *Lat.* 5° N.
6. An insignificant spot, followed by two dots.
7. Leader with penumbra to the W., and many small nuclei, almost a zigzag of little spots f.
8. Leader more amalgamated, but with less penumbra, f. spots gone.
9. More normal:
10. Without penumbra; two pairs and a few dots f.
11. Two spots only; fading away.
12. Two spots and a few dots.
13. Three extremely small spots.

Nov. GROUP 245. *Long.* 81°. *Lat.* 23° N.
7. A small spot near E. limb.
8. Two nuclei.
9. Little change.
10. Very small.

Nov. GROUP 246. *Long.* 67° to 63°. *Lat.* 4° to 6° S.
8. A large spot near E. limb.
9. Apparently double, four nuclei.
10. Nucleus large in the form of a Z, penumbra regular, a portion p. severed from the main spot with six nuclei.
11. Nucleus more split up; p. portion re-united.
12. Amazingly elongated, p. portion nearly contiguous; as many as 10 distinct nuclei in a row producing a singular effect, length 1′ 50″, "changing under the eye."
13. More bulging at the head.
15. Still elongated, but the nuclei more connected, about seven in all; there is now a severance at the rear as well as in front.

Nov. GROUP 247. *Long.* 56°. *Lat.* 7° S.
8. A compound spot f. 245.
9. Two spots N. and S. of each other.
10. Spot to the N. with three nuclei, sputterings f. spot to the S. dispersed.
11. Very intricate, nuclei smaller, a one-sided spot p., followers hardly more than dots.
12. Split into three sections, the most southerly composed of four nuclei only.
13. One principal spot.
15. Very much diminished, hardly any penumbra.

Nov. GROUP 248. *Long.* 107°. *Lat.* 31° S.
9. A few very faint spots to the E. of centre of disk.
10. Six small black spots and six dots.
11. Two very small spots and five dots.

Nov. GROUP 249. *Long.* 154° to 147°. *Lat.* 18° to 20° N.
11. Two sets of little spots some distance apart, past the centre of disk.
12. Two spots with slight penumbra on one side.
13. The most northerly spot very small.

Nov. GROUP 250. *Long.* 73°. *Lat.* 11° N.
9. Five or six little spots where faculæ were observed on the 8th.
10. Two pairs of small black spots.
11. Two sets of small spots.
12. Two of the spots much larger. Many dots.
13. Some of the dots increased.
15. One nebulous spot p., two small ones f. at some distance.



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Nov. GROUP 251. *Long.* 62° to 51°. *Lat.* 10° to 13° N.
10. Two pairs of small black spots.
11. A train of small spots and dots, the last with three nuclei and slight penumbra.
12. Three spots rather larger.
13. The most p. spot with penumbra on the N. f. side, train in a curved line.
15. P. spot normal, f. all small, none now near the leader.
19. One small spot.
20. Near W. limb.

Nov. GROUP 252. *Long.* 48° to 41°. *Lat.* 20° N.
11. A normal spot not far from E. limb.
12. One-sided, with divided nucleus, some scattered outliers p.
13. More outliers.
15. Two spots nearly equal, major axis about 20″ of arc, penumbra on opposite sides, four or five outliers.

Nov. GROUP 252*. *Long.* 116°. *Lat.* 13° S.
13. A very small spot.
15. Near W. limb, in the midst of faculæ.

Nov. GROUP 253. *Long.* 50° to 46°. *Lat.* 9° S.
11. Two small black nuclei following Group 247.
12. Four little spots in a curved line N. and S. of each other, some attendant dots.
13. More in number, positions altered.
15. Three, with a little penumbra.

Nov. GROUP 254. *Long.* 41° to 32°. *Lat.* 30° to 35° S.
11. Five small spots near E. limb.
12. A penumbral spot, an indistinct pair 9° to the S. of it.
13. Decreasing.
15. The N. spot very small, the pair with penumbra on opposite sides.

Nov. GROUP 255. *Long.* 15°. *Lat.* 14° to 20° N.
12. A considerable spot near E. limb, with more than five nuclei lying N. and S of each other.
13. Nuclei closer together, wavy in outline.
15. A large nucleus in the form of an S. A portion detached to the N. Two sets of small irregular spots f.
19. Three spots, the last curving round, with three nuclei.
20. Quite altered, the two p. spots now form one, major axis 45″, the last part fading.
21. A normal spot with two nuclei, no outliers.
22. Penumbra S. f.
23. Penumbra nearly equalised.
24. Near W. limb.

Nov. GROUP 256. *Long.* 339°. *Lat.* 5° S.
15. A normal spot not far from E. limb.
19. Penumbra only on the p. side.
20. Two nuclei.
21. Nearly circular, three or four nuclei.
22. Decreasing, two nuclei.
23. Split in two.
24. One spot.
25. Very small.

Nov. GROUP 257. *Long.* 333°. *Lat.* 20° S.
19. A small normal spot resembling 256 in character and behaviour.
20. Nucleus divided.
21. Nearly circular.
22. Decreasing, two nuclei.
23. A pair.
24. Smaller.
25. A still smaller spot to the S. and two dots.
26. Near W. limb.



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Nov. GROUP 258. *Long.* 335° to 325°. *Lat.* 20° N.

19. A train of small penumbral spots, the most f. larger than the rest.
20. Five spots much increased, penumbra on one side of each, form of group triangular.
21. Two large spots, a few little ones between them, the p. oval, with small nuclei, the most f. normal.
22. The p. with three nuclei, in a triangle, penumbra all round, major axis 45″. The most f. irregular and divided.
23. P. normal, more vertical, nucleus curved, f. elongated, penumbra to the S., scattered dots only between.
24. No radical change.
25. P. with nucleus almost split in two. F. reduced to a very small spot and three dots.
26. Nucleus like a Greek τ. Two very small spots and nine dots f.
27. Very near W. limb at 11 a.m. Two nuclei lying side by side.

Nov. GROUP 259. *Long.* 327° to 317°. *Lat.* 1° to 9° S.

19. A very large compound spot (more than three days from the centre), containing a great amount of penumbra and many small adjacent spots, the whole forming a somewhat quadrangular mass.
20. One nucleus to the N. larger than the rest, which are mostly distinct from each other and pretty evenly distributed, penumbra winding in and out amongst them. Area 5,400 square seconds.
21. No drawing.
22. A portion to the N., containing the large nucleus which has now three smaller linear ones near it, beginning to form a separate spot, whole group more intersected, especially the outlying portions; a large preponderance of penumbra in the centre.
23. N. spot more normal, central penumbra branching and almost destitute of nuclei. A further tendency to form distinct spots.
24. More thinned out.
25. Further disintegration. Chief spot larger and rounder, with jagged and intricate nucleus, the rest a tangled labyrinth of many small spots, penumbra, and dots, varying greatly in form and position. General outline still quadrangular.
26. Chief spot more normal, bridged, nucleus still jagged, but penumbra less so. Whole mass stream-like, partly from the decrease in penumbra, partly from foreshortening.
27. Principal spot with two nuclei, penumbra nearly equal on both sides, several wavy patches with few nuclei S. f. One minor spot quite solitary.
28. Close to W. limb at 4.24. Visible as a long sinuous line of great extent.

Nov. GROUP 260. *Long.* 306°. *Lat.* 11° N.

23. A small but normal spot followed by a few dots.
24. No drawing.
25. Two little black spots and some dashes.
26. Two spots and two dots.
27. Extremely small.

Nov. GROUP 261. *Long.* 228° to 214°. *Lat.* 15° to 19° N.

25. A pair of small spots, six more f., all pairs, dots also at some distance, in all 17 in number.
26. In all 22, without penumbra, more than half of them dots.
27. Much increased, a train widening out at the end, five or six with partially surrounding penumbra, tending to circularity.
28. Leader a well-defined spot, evidently resulting from the union of several, containing six black nuclei in a double row, penumbra not quite encompassing the whole, the most f. spot also with a row of nuclei, and attracting more to itself.
29. Leader with large circular nucleus, penumbra only in front, three of the black nuclei of yesterday having united and formed another definite spot, with penumbra on the opposite side. Most f. with nuclei less divided.



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Dec. GROUP 261—*continued.*

1. Leader elongating, nucleus split up, a stream of spots and dots between, the most f. double.
2. Leader with streamers from the nucleus and dots on the S. f. edge. Most f. dissolved into a mass of small nuclei.
3. Leader with forked nucleus, and gap in penumbra, f. spots fewer but larger, the most f. solitary.
4. Nucleus more hooked, penumbra closed up, but with two horns. Many small followers, a zigzag.

Nov. GROUP 262. *Long.* 243°. *Lat.* 17° N.

28. A few little spots, near the centre of disk, the most f. penumbral.
29. More in number.

Dec.

1. P. spots dwindling, the f. more normal, nucleus double.
2. Two spots only.
3. One spot.

Nov. GROUP 263. *Long.* 150° to 130°. *Lat.* 16° to 22° N.

29. A normal spot, with two smaller ones near E. limb.

Dec.

1. A train, leader large, with bridged nucleus curved on the f. side, irregular spots f., two of them a pair, N. and S. of each other, final spot normal.
2. Leader with nucleus more divided, f. spots more penumbral, one of them joined to the leader, the pair in conjunction, the southern half consisting of penumbra only. Final spot with a detached portion on the f. side. Two new outliers f.
3. Leader with four sharply divided nuclei, two curving opposite ways, and one very narrow, penumbral followers wavy, sprinkled with small nuclei. Intermediates in curves with the re-united pair again severed, and a patch of penumbra to the S. of them. New f. spots decreasing.
4. Leader with five nuclei, the narrow one more thread-like, with a larger one on either side curling outwards; light around them. The penumbral followers a perfect maze of sputterings, nuclei and penumbra stretching above and below, and ending in streams of dots and fragments. Intermediates also more widespread, the pair again a single spot, with two nuclei close together. Final less broken at the extremity.
6. Nuclei of leader larger, very intricate and more confluent, resembling a Hebrew character, the narrow one absorbed. Wing-like branches of penumbra f. Intermediates a thin vaporous stream. Final oval and normal.
7. Nucleus less complex, penumbral wings gone. Final with double nucleus.
8. Leader becoming more normal. No details.
9. Many small nuclei, four in a line, with light centrally, outliers more nuclear. Intermediates small and disconnected. Final more angular.
10. Two nuclei, one only half the size of the other, penumbra pretty equal in a long stretch to the S. Intermediates gone. Final with one of the nuclei crescent-shaped.
11. Near W. limb at 12.45. Final more broken up.

Dec. GROUP 264. *Long.* 148° to 145°. *Lat.* 21° S.

3. A few very small spots.
4. Three spots, one of them a pair.
6. Rather more.
7. One, with slight penumbra and two dots.

Dec. GROUP 265. *Long.* 104°. *Lat.* 12° S.

4. A single dot in the midst of faculæ not very far from E. limb.
6. Two conspicuous black dots.



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Dec. GROUP 265.* *Long.* 47° to 39°. *Lat.* 14° to 19° N.

10. A cluster, wide-spread, of small spots; if existing on the 9th, very small indeed as it was not observed.
11. Greatly changed. A group of many sharp nuclei and dots, one only with decided penumbra.
12. Curious streams of small spots. Three principal centres of activity.
13. A confused mass of sputterings rather than streams. The p. increased.
14. Expanding in front, nuclei larger, the biggest spot with streamers of white matter between the nuclei, penumbra to the S. The whole rapidly changing.
15. More condensed; stragglers decreasing.
16. Two rows of nuclei p. forming a triangle, with penumbra on opposite sides; followers fewer.
17. Two penumbral spots, the f. dying out. Some new ones at a considererable distance to the E.
18. In two sets, new f. increased; one almost normal.
19. Four sets, two spots near limb; the most f. compound.
20. One spot only visible at 11.30 a.m.

Dec. GROUP 266. *Long.* 335°. *Lat.* 18° N.

12. A normal spot near E. limb. A return of 258.
13. Little change.
14. Little change.
15. More irregular.
16. Nucleus double.
17. Circular.
18. Decreasing, very little penumbra.
19. Two nuclei, small stream of white matter invading them.
20. Penumbra only to the S.
21. Very small.
22. Almost gone.

Dec. GROUP 267. *Long.* 329°. *Lat.* 1° S.

13. A normal spot, penumbra wider on the f. side. (A return of 259.)
14. One large spot, one small one, and six black dots.
15. Some of the dots increased.
16. Many outliers S. f. Extending as far as 10° S.
17. Outliers diminishing.
18. Chief spot bridged. Outliers more dispersed.
19. Two p. outliers larger.
20. Little change.
21. Nucleus not bridged.
22. Two "black holes" in nucleus, outliers in a stream, small.
23. Outliers gone.
25. Near W. limb at 11.45.

Dec. GROUP 268. *Long.* 326°. *Lat.* 13° N. (Chief spot.)

13. Three spots near E. limb at 11 a.m.
14. Spots irregular, streams of small ones between.
15. Two spots with penumbra, the p. with three nuclei.
16. P. double, a few outliers, no streams.
17. One spot only penumbral, nucleus angular.
18. Broken in front, tapering at the end.
19. Head much dislocated, a stream of very small followers.
20. Nucleus more entire, two-lobed.
21. Nucleus broken up in the centre.
22. More broken, penumbra only on the p. side.
23. Penumbra on both sides, but detached, and beaded with tiny nuclei on the p. side.
25. Near W. limb at 1.12.



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Dec. GROUP 269. *Long.* 314° to 303°. *Lat.* 5° to 9° S.

14. A spot near E. limb with double nucleus.
15. Nucleus and penumbra with a horn-like projection on the f. side. Some irregular spots f.
16. More normal, nucleus twisted. F. spots in a cluster.
17. Nucleus bulging in front. F. spots showing repulsion.
18. More circular, nucleus bridged with whitish matter, a narrow forked fissure to the S. Area 2,430 square seconds.
19. F. spots more numerous but scattered, two with penumbra.
20. Nucleus entire, f. spots inclined to stream formation.
21. Major axis 1′ 6″. Nucleus with a point at the extremity; f. spots altered in form and position.
22. Circular, normal, "black hole" in centre. One of the f. spots with two parallel nuclei and a thin white bridge between.
23. More quadrangular, the f. spot opening at right angles, with a little very transparent penumbra.
25. Near W. limb.

Dec. GROUP 270. *Long.* 254° to 247°. *Lat.* 9 to 12° N.

18. A spot very near E. limb at 4.30 p.m.
19. Two spots, the p. with double nucleus, the f. smaller.
20. P. more entire, f. compound.
21. P. with dense nucleus, a black hole in centre; f. larger, one-sided, a few outliers.
22. P. oval, much fimbriated, dots issuing from the extremity; f. broken up, with many small and some sharp nuclei.
23. P. pear-shaped, f. a mass of small fragments. A new spot more E.
25. P. compound, nuclei in a curve, f. all dwindling. Area 2,200 square seconds.
26. P. more vertical, double.
27. More equatorially inclined. New outliers to the N.
28. Extremity nearly severed, a stream of small nuclei, besides dots f.
29. Nearing W. limb, a few of the f. increased.
30. Smaller, but more normal, penumbra on the f. side.

Dec. GROUP 271. *Long.* 255°. *Lat.* 18° N.

18. A small spot close to E. limb at 4.30 p.m.
19. Double.
20. A pair.
21. Four spots.
22. In a row.
23. Two only.

Dec. GROUP 272. *Long.* 235° to 231°. *Lat.* 26° to 28° S.

20. A penumbral spot near E. limb.
21. Nucleus divided.
22. A fine set of bridges.
23. Nuclei in a trefoil.
25. In the form of a helix, many sputterings.
26. More normal.
27. Penumbra wanting to the N. More small nuclei.
28. Full of detail, penumbra encircling the whole.
29. A few outliers p.
30. Solitary, more regular.
31. Nucleus angular.

Dec. GROUP 273. *Long.* 243° to 226°. *Lat.* 14° to 20° N.

20. A few little spots near E. limb.
21. One with penumbra.
22. A spot hollowed out, as it were, with small nuclei in a triangle to the S. Small spots p. in a row.
23. Split in two, the p. fewer and more dispersed.
25. A long curved train of sparsely scattered spots, all small.



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Dec. GROUP 273—*continued.*

26. In two sets.
27. The first set a stream.
28. Decreasing.
29. No details.
30. A few only of the p. left.
31. Very small.

Dec. GROUP 274. *Long.* 242° to 228°. *Lat.* 18° to 22° S.

20. Three very small spots followed by a larger one.
21. More small spots.
22. Two principal spots, the leader, A., with compound nucleus, the f., B., with five nuclei and fragments to the S.
23. A. one sided, B. with six nuclei, major axis, 40″.
25. A. more normal, B. with nuclei in a row.
26. A. and B. 13° apart, a few small spots between them.
27. A. forked at the end, B. without penumbra to the S., and nuclei much divided, one small spot increased.
28. A. pear-shaped, B. very complex, dots in the vicinity.
29. B. breaking up.
30. A. decreasing, B. reduced to two small spots.
31. A. normal, B. not seen.

Dec. GROUP 275. *Long.* 233°. *Lat.* 3° S.

21. A small spot near E. limb.
22. Nearly normal, many small followers.
23. Reduced. Dots and tiny nuclei f. in a semicircle.
24. Nucleus bridged, the f. larger, but not elliptical.
25. Broken up at the f. end, with nuclei bursting out.
26. More regular.
27. Nucleus sharply and unevenly divided, a stream of dots to the N.
28. Nucleus forked in front. No outliers.
29. Circular; nucleus double.
30. Nucleus just bridged, a little stream of new spots p.
31. Nearing W. limb, one of the p. larger.

Dec. GROUP 276. *Long.* 228°. *Lat.* 5° S.

22. Many little spots lying N. and S. of each other with a mixture of penumbra (f. Group 275).
23. A semicircle of tiny nuclei, hardly more than dots, and a tracery of penumbra (resembling 275 on this date).
25. A cluster of small spots. On this date there were five spots in different groups, with nearly the same area, and resembling each other in character.
26. More extended.
27. A stream expanded at the end.
28. Cyclonic. More dots than spots.
29. Scattered.
30. Two spots rather larger.
31. Fast fading.

Dec. GROUP 277. *Long.* 312° to 302°. *Lat.* 11° N.

23. An elliptical group of small spots, a new outburst.
25. One spot, with penumbra.
26. Near W. limb.

Dec. GROUP 278. *Long.* 199° to 187°. *Lat.* 3° to 16° S.

23. A small penumbral spot near E. limb.
25. Half-moon shaped, a swarm of small spots f.
26. More normal, the f. spots in a train.
27. Leader with nucleus fimbriated, in form helical, and a tail-like appendage. F. spots very numerous and complex, with sharp irregular nuclei.
28. Nucleus oval, appendage broken up.



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Dec. GROUP 278—*continued.*

29. F. spots coalescing.
30. Leader more vertical, elongated, again curved round at the extremity. The f. combining and forming two large spots, with a multitude of small adjacent nuclei, some of them in streams.
31. Leader with double nucleus, two little spots at the extremity. F. very complex, the two large spots still accompanied by many fragments and penumbral patches.

Dec. GROUP 279. *Long.* 167°. *Lat.* 9° S.

25. A normal spot near E. limb.
26. Smaller ones f.
27. Nucleus double, fimbriated, a spot on the f. side apparently detached.
28. Detached spot re-united at one point.
29. Nucleus still double.
30. Bridged, small spot with two nuclei, another f.
31. Nearly circular, diameter about 45″.

Dec. GROUP 280. *Long.* 157° to 153°. *Lat.* 16° to 17° N.

26. An indefinite spot near E. limb in the midst of faculæ.
27. Nucleus divided, penumbra on the p. side.
28. Much altered, a few fragments p., a spot with triple nucleus f., and a few outliers.
29. A little train.
30. Spots small and indistinct.
31. Three little spots followed by a nebulous cluster.

Dec. GROUP 281. *Long.* 154°. *Lat.* 11° S.

26. A spot f. 279, with double nucleus.
27. In the shape of an S., a few small attendants.
30. Nucleus much and sharply divided.
29. No details.
30. Two dense nuclei, major axis nearly 45″, equal to 279 p.
31. Almost split in two.

Dec. GROUP 282. *Long.* 144°. *Lat.* 7° S.

30. A very small spot f. 281.

Dec. GROUP 283. *Long.* 137°. *Lat.* 18° S.

30. An insignificant spot S. f. 281.
31. Two spots.

Dec. GROUP 284. *Long.* 117° to 96°. *Lat.* 10° to 17° S.

30. Some small widely scattered spots near E. limb.
31. No increase in area.

Dec. GROUP 285. *Long.* 100°. *Lat.* 11° N.

30. One little spot near E. limb, preceded by faculæ on the 29th.
31. A few more.



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## Solar Statistics in 1893.

By E. W. MAUNDER, F.R.A.S.

The following tables are in continuation of those which I have given in previous Reports of the Solar Section, and, as before are derived from the results obtained at the observatories of Greenwich, and Zurich, and of the Collegio Romano. Prof. Tacchini's results have been published in the "Comptes Rendus," Vol. CXVI, No. 19, p. 1035; Vol. XCVII, No. 24, p. 841; and Vol. CXVIII, No. 8, p. 394.

TABLE I.—*Sunspots and Faculæ.*

| 1893. | Prof. Tacchini's Observations. | | | | | | Greenwich Photographs. | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. of Days of Observation. | Comparative Frequence | | Comparative Area | | No. of Groups of Spots per Day. | No. of Days of Observation. | No. of Days without Spots. | Mean Area in Millionths of the Sun's Visible Hemisphere. | |
| | | Of Spots. | Of Days without Spots. | Of Spots. | Of Faculæ. | | | | Spots. | Faculæ. |
| January | 20 | 23·10 | 0·00 | 98·4 | 43·5 | 5·0 | 31 | 0 | 1,122 | 2,305 |
| February | 20 | 23·60 | 0·00 | 100·7 | 53·2 | 4·7 | 28 | 0 | 1,261 | 2,001 |
| March | 30 | 19·50 | 0·00 | 81·3 | 66·3 | 4·9 | 30 | 0 | 971 | 1,942 |
| April | 28 | 29·11 | 0·00 | 110·5 | 99·6 | 7·3 | 30 | 0 | 1194 | 2,379 |
| May | 25 | 23·16 | 0·00 | 95·2 | 89·8 | 7·0 | 31 | 0 | 1,158 | 2,668 |
| June | 27 | 28·74 | 0·00 | 101·3 | 63·9 | 6·9 | 29 | 0 | 1,362 | 2,848 |
| July | 30 | 26·30 | 0·00 | 138·1 | 94·2 | 7·3 | 31 | 0 | 1,500 | 2,726 |
| August | 31 | 44·84 | 0·00 | 227·5 | 111.0 | 10·2 | 31 | 0 | 2,544 | 3.053 |
| September | 30 | 30·77 | 0·00 | 141·1 | 134.0 | 6·7 | 30 | 0 | 1,667 | 2,470 |
| October | 27 | 26·85 | 0·00 | 112·7 | 89·2 | 7·4 | 31 | 0 | 1,529 | 2,285 |
| November | 20 | 23·15 | 0·00 | 96·4 | 84·0 | 5·4 | 28 | 0 | 1,266 | 1,338 |
| December | 27 | 33·89 | 0·00 | 166·4 | 86·0 | 8·0 | 30 | 0 | 1,996 | 1,879 |
| Mean | 26 | 28·24 | 0·00 | 125·47 | 86·92 | 6·88 | 30 | 0 | 1,464 | 2,328 |
| Mean for 1892 | 24 | 22·38 | 0·00 | 108·26 | 71·81 | 5·49 | 30 | 0 | 1,220 | 3,243 |
| Mean for 1891 | 24 | 10·97 | 0·05 | 48·13 | 64·21 | 3·21 | 30 | 1 | 566 | 1,379 |
| Mean for 1890 | 23 | 2·68 | 0·56 | 8·41 | 16·64 | 0·66 | 30 | 15 | 100 | 300 |
| Mean for 1889 | 24 | 2·01 | 0·62 | 8·61 | 12·56 | 0·50 | 30 | 18 | 78 | 131 |



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TABLE II.—*Chromosphere and Prominences.*

| 1893. | Prof. Tacchini's Observations. | | | |
|---|---|---|---|---|
| | No. of Days of Observation. | Prominences. | | |
| | | Mean No. | Mean Height. | Mean Extent. |
| | | | " | ° |
| January - - | 17 | 8·12 | 41·5 | 2·1 |
| February - - - | 22 | 9·00 | 37·5 | 1·9 |
| March - - - | 29 | 9·10 | 38·0 | 1·9 |
| April - - - - | 26 | 11·58 | 39·3 | 1·8 |
| May - - - | 21 | 6·52 | 40·1 | 1·9 |
| June - - - - | 26 | 5·81 | 38·8 | 1·9 |
| July - - - | 26 | 6·23 | 37·4 | 1·7 |
| August - - - | 29 | 8·73 | 36·3 | 1·8 |
| September - - | 26 | 6·77 | 36·5 | 1·7 |
| October - - - | 22 | 5·82 | 36·2 | 1·9 |
| November - - | 13 | 5·00 | 34·7 | 1·8 |
| December - - - | 23 | 6·48 | 35·5 | 1·9 |
| Mean - - - | 23 | 7·58 | 37·7 | 1·8 |
| Mean for 1892 - - | 21 | 9·19 | 39·6 | 1·9 |
| Mean for 1891 - - | 21 | 7·06 | 40·4 | 1·7 |
| Mean for 1890 - - | 20 | 2·84 | 33·9 | 1·3 |
| Mean for 1889 - - | 19 | 3·09 | 33·8 | 1·1 |

The above tables show that the increase in the spotted area of the sun was maintained during 1893, August showing a mean daily area more than half as large again as that for February in 1892. In all probability August 1893 marks the apex of the sun-spot curve, and though December 1893 showed a marked revival, and surpassed the heaviest month of 1892, there has been, on the whole, a marked and steady decline since the close of the August disturbances. But whilst there was this increase in the sun-spots, there was a very marked decline as to faculæ, and a slight falling off in the chromospheric phenomena. The year also showed a decline in the frequency and violence of magnetic storms, and auroræ were comparatively few and inconspicuous, a fact of great importance in its bearing on the connexion between these various orders of solar and terrestrial phenomena. On the whole, we may conclude that the solar maximum had already been definitely passed by the end of 1893.



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## GROUPS, (1) CXCIV. (2) CXCV.

1

2

Aug. 31. 3.45 P.M. 3in. O.G. By Projection. Scale, Sun's image = 85 in. diam. E.B. del.

1

2

Sep. 2. 12.13 to 35. E.B. del.

Tailby & Price lith.

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## GROUPS, (1) CXCIV. (2) CXCV.

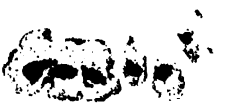
1

2

Sep. 3. 9.45 A.M. E.B. del.

1

2



Sep. 4. 9 A.M. E.B. del.

1

2

Sep. 6. Scale smaller. 6½ in. Spec. By Projection. E.Corder del.

Tuilby & Price lith.

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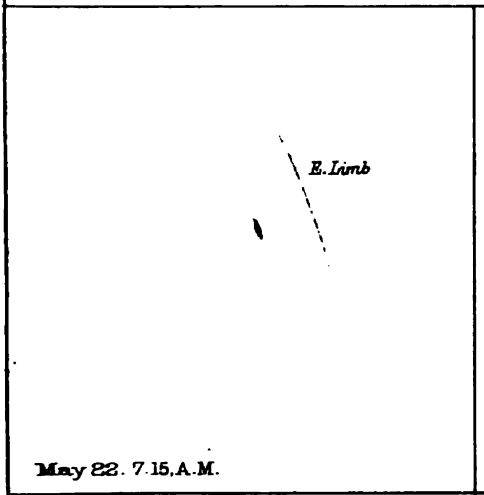
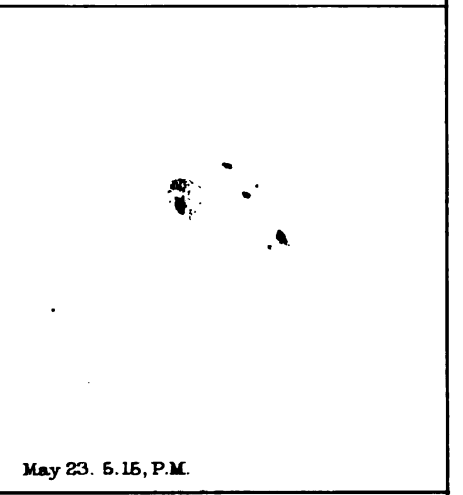
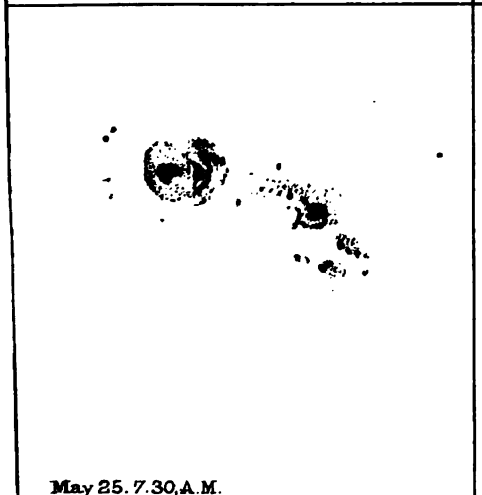
# GROUP CIX.



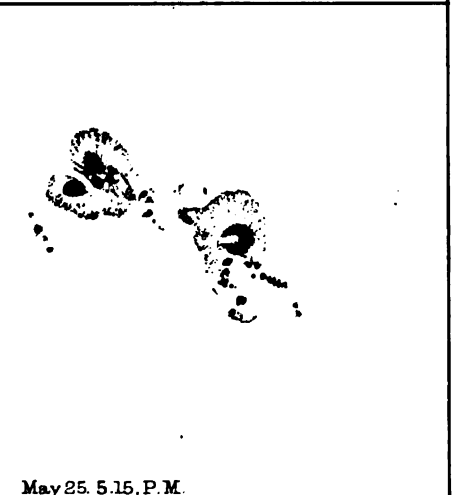

May 22. 7.15, A.M.



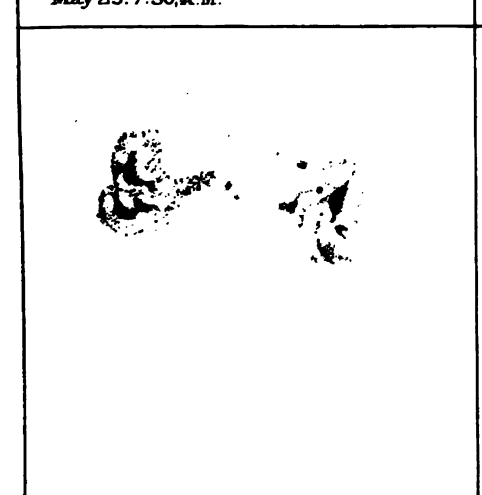
May 23. 5.15, P.M.



May 25. 7.30, A.M.



May 25. 5.15, P.M.



May 26. 9.15, A.M.

May 27. 9.20, A.M.

E. B. del.

Tuilby & Price lith.

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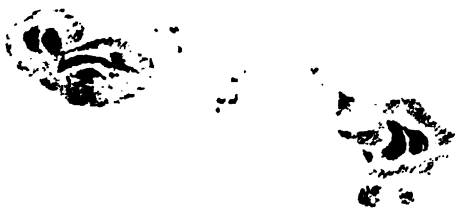
## GROUP CIX.



May 28. 7, A.M. E.B. del.

May 29. 4, P.M. by Projection. 3in O.G. E.B. del.

May 31. Scale smaller. by Projection. 4in O.G. J.Bartlett del.

Tailby & Price lith

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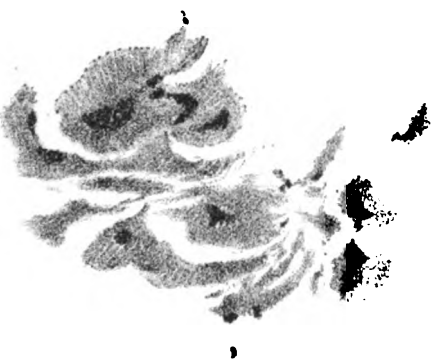
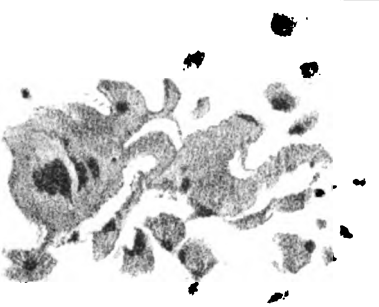
## GROUP CCLIX.

Nov. 19. 12.



Nov. 20. 1, P.M.



Nov. 22. 11, A.M.

E. B. del.

Tealby & Price lith.

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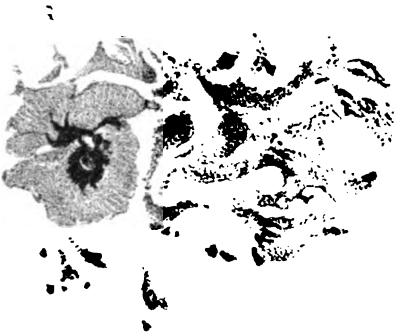
## GROUP CCLIX.



Nov. 25. 11, A.M. 4½in. O.G.

Nov. 26. 10.30, A.M.

Nov. 27. 10.12, A.M.

J. as M. Pereira del. Tailby & Price lith.

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# SECTION FOR THE OBSERVATION

OF

# JUPITER.

DIRECTOR.—REV. W. R. WAUGH, F.R.A.S.

## *THIRD REPORT OF THE SECTION.*

### REPORT FOR THE APPARITION OF 1893 AND 1894.

## PART 1.

The following Table gives the names of the registered Members of the Section; the localities of observation; the instruments used; the number of drawings returned; and the inclusive dates of the drawings.

TABLE I.

| Names. | Locality. | Instrument. | No. | Inclusive Dates. |
|---|---|---|---|---|
| E. M. ANTONIADI | Paris, Juvissy | 4½-in., 9½-in. O.G. | 13 | Sept. 24, 1893; Oct. 24, 1893. |
| Rev. J. BAIKIE | Ancrum | — | — | — |
| LEO BRENNER | Lussinpiccolo | — | — | — |
| Rev. J. BONE, M.A., F.R.A.S. | Lancaster | — | — | — |
| G. L. BROWN | Stirling | 3½-in. O.G., 10½-in. spec. | 5 | Jan. 28, 1894; Apr. 20, 1894. |
| L. J. BROWN | Shepherd's Bush. | — | — | — |
| R. W. BUTTEMER | Godalming | 9½-in. spec. | 4 | Aug. 15, 1893; Nov. 5, 1893. |
| B. E. CAMMELL, F.R.A.S. | Wokingham | 12½-in. spec. | 26 | Sept. 15, 1893; Feb. 27, 1894. |
| Dr. CASSIDY | Lancaster | — | — | — |
| T. R. CLAPHAM, F.R.A.S. | Lancaster | — | — | — |
| E. J. COPE | West Malvern | 8½-in. spec. | 8 | Sept. 4, 1893; Jan. 1, 1894. |
| H. CORDER | Bridgewater | 6½-in. spec. | 10 | Aug. 13, 1893; Feb. 8, 1894. |



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| Names. | Locality. | Instrument. | No. | Inclusive Dates. |
|---|---|---|---|---|
| A. COTTAM, F.R.A.S. | Watford | — | — | — |
| Rev. Dr. CRAIG, F.R.A.S. | Londonderry | — | — | — |
| R. CROSS | Oxford | — | — | — |
| G. T. DAVIS | Reading | 3½-in. O.G. | 27 | Sept. 15, 1893; Mar 27, 1894. |
| HENRY ELLIS | Potter's Bar | 6-in. O.G. | 13 | Sept. 30, 1893; Dec. 23, 1893. |
| E. ESSAM | Billingborough | 8½-in. spec. | 2 | Jan. 31, 1894; Mar. 11, 1894. |
| J. EVERSHED, F.R.A.S. | Kenley | 9½-in. spec. | 4 | Oct. 26, 1893; Nov. 22, 1893. |
| Rev. T. A. FOULKES, M.A. | Devonport | 5-in. O.G. | 10 | Oct. 1, 1893; Dec. 25, 1893. |
| A. FREEMAN | Brighton | — | — | — |
| W. GOODACRE, F.R.A.S. | Highgate | 12-in. spec. | 9 | Oct. 31, 1893; Dec. 30, 1893. |
| G. P. P. HALLOWES, F.R.A.S. | Brough | — | — | — |
| E. RUPERT HICKS | Kensington | — | — | — |
| Rev. R. S. HUTCHINGS, F.R.A.S., | Alderbury | — | — | — |
| W. H. IZZARD | Brentford | — | — | — |
| J. JACKSON | Blackpool | — | — | — |
| W. E. JACKSON, F.R.A.S. | Constantinople | — | — | — |
| Rev. S. J. JOHNSON, M.A., F.R.A.S. | Melplash | — | — | — |
| Rev. P. H. KEMPTHORNE, M.A., F.R.A.S. | Wellington College. | — | — | — |
| HY. MACEWEN, F.R.A.S. | Glasgow | 5-in. O.G. | 12 | Aug. 11, 1893; Nov. 20, 1893. |
| W. H. MAW, F.R.A.S. | Kensington | 6-in. O.G. | 12 | Oct. 8, 1893; Mar. 4, 1894. |
| J. W. MEARES | Chelmsford | 3½-in. O.G. | — | — |
| ARTHUR MEE, F.R.A.S. | Cardiff | 8½-in. spec. | 29 | Sept. 30, 1893; Mar. 6, 1894. |
| LIEUT. P. B. MOLESWORTH | Hong Kong | 9½-in. spec. | — | — |
| J. M. OFFORD, F.R.M.S. | St. John's Wood. | 12½-in. spec. | 14 | Oct. 30, 1893; Feb. 8, 1894. |
| H. PHILLIPS | Hereford | — | — | — |
| Rev. VINCENT REID | Glasgow | — | — | — |
| C. ROBERTS | Bournemouth | — | — | — |
| Dr. R. J. RYLE, M.A. | Hadley | 8½-in. spec. | 7 | Oct. 18, 1893; Jan. 12, 1894. |
| Dr. SMART, F.R.A.S. | Bermondsey | 10½-in. spec. | 4 | Sept. 26, 1893; Mar. 2, 1894. |
| Rev. J. H. TUCKFIELD, M.A. | Tasmania | — | — | — |
| Rev. W. R. WAUGH, F.R.A.S. | Portland | 4½-in. O.G., 12½-in. spec. | 21 | Aug. 14, 1893; Mar. 29, 1894. |
| Rev. J. WEBSTER, M.A. | Tiverton | — | — | — |
| A. STANLEY WILLIAMS, F.R.A.S. | Brighton | — | — | — |
| Rev. L. A. WILLIAMS | Dorchester | 4-in. O.G. | 5 | Oct. 31, 1893; Dec. 16, 1893. |
| W. H. WOOSTER | Ballarat | — | — | — |
| J. WYKES | Bournbook | 4½-in. O.G. | 16 | Aug. 12, 1893; Mar. 27, 1894. |

Several of the above, who have not returned drawings, have sent satellite or other useful returns; a few are quite recent Members.



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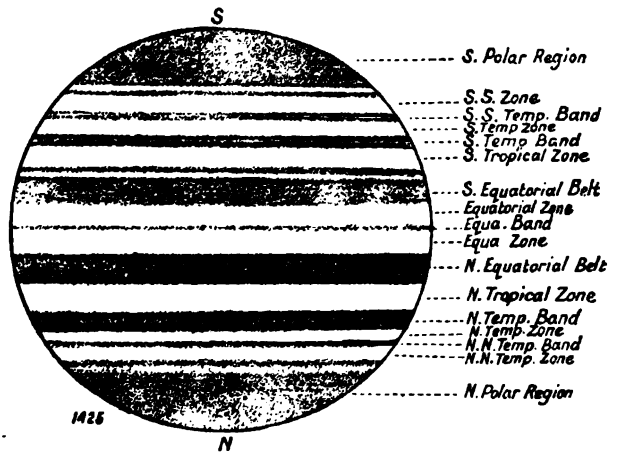
In the above list a rather large proportion have not sent formal and available returns, owing to various personal considerations. All but two have expressed their desire to remain in the Section, and hope to do satisfactory work during the apparition of 1894–5. It is gratifying to know that none have expressed a desire to abandon their sectional position, so it may be reasonably hoped that there will soon be a far larger proportion of real workers. The Director has no hesitation in saying that the character and quality, as well as the number of the drawings and observations, have vastly improved, and will well bear the forbearing criticism which experts always apply to amateur work, especially where many are necessarily in the intitial stages as planetary observers.

The total number of drawings returned is 252. Many of these are accompanied with copious descriptions, a selection from which is included in the body of the report. Much that might have been included in this Memoir, however, has been already brought before the Association in the form of interim papers, some of which have appeared in a condensed form in the "Journal." These brief notes have been found useful in stimulating and sustaining interest in the work, and on behalf of the Members the Director would express thanks for the kindly criticisms and discussions which these reports have sometimes evoked.

In order to render the terminology employed in this report easily understood, the diagram which appeared in the last Memoir is reproduced here. It has been found so useful in the Section




that it is hoped it will prove a permanent contribution for designating Jovian features among observers of every degree.

Our fickle climate during the apparition of 1893–4 has not been so propitious as desired, indeed the usual complaints as to observing weather have been emphasised. The opportunities for observing the more delicate planetary markings have been few and far between. Those whose health and avocations have permitted observations during the early morning hours have not been so greatly discounted.



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| Names. | Locality. | Instrument. | No. | Inc |
|---|---|---|---|---|
| A. COTTAM, F.R.A.S. | Watford | — | — | |
| Rev. Dr. CRAIG, F.R.A.S. | Londonderry | — | — | |
| R. CROSS | Oxford | — | — | |
| G. T. DAVIS | Reading | 3¾-in. O.G. | 27 | 8 |
| HENRY ELLIS | Potter's Bar | 6-in. O.G. | 13 | 5 |
| E. ESSAM | Billingborough | 8½-in. spec. | 2 | |
| J. EVERSHED, F.R.A.S. | Kenley | 9½-in. spec. | 4 | |
| Rev. T. A. FOULKES, M.A. | Devonport | 5-in. O.G. | 10 | |
| A. FREEMAN | Brighton | — | — | |
| W. GOODACRE, F.R.A.S. | Highgate | 12-in. spec. | 9 | |
| G. P. P. HALLOWES, F.R.A.S. | Brough | — | — | |
| E. RUPERT HICKS | Kensington | — | | |
| Rev. R. S. HUTCHINGS, F.R.A.S., | Alderbury | — | | |
| W. H. IZZARD | Brentford | — | | |
| J. JACKSON | Blackpool | — | | |
| W. E. JACKSON, F.R.A.S. | Constantinople | — | | |
| Rev. S. J. JOHNSON, M.A., F.R.A.S. | Melplash | — | | |
| Rev. P. H. KEMPTHORNE, M.A., F.R.A.S. | Wellington College. | — | | |
| HY. MACEWEN, F.R.A.S. | Glasgow | 5-in. O.G. | | |
| W. H. MAW, F.R.A.S. | Kensington | 6-in. O.G. | | |
| J. W. MEARES | Chelmsford | 3¾-in. O.G. | | |
| ARTHUR MEE, F.R.A.S. | Cardiff | 8½-in. sp. | | |
| LIEUT. P. B. MOLESWORTH | Hong Kong | 9½-in. sp. | | |
| J. M. OFFORD, F.R.M.S. | St. John's Wood. | 12¾-in. | | |
| H. PHILLIPS | Hereford | — | | |
| Rev. VINCENT REID | Glasgow | — | | |
| C. ROBERTS | Bournemouth | — | | |
| Dr. R. J. RYLE, M.A. | Hadley | 8½-in. | | |
| Dr. SMART, F.R.A.S. | Bermondsey | 10½ | | |
| Rev. J. H. TUCKFIELD, M.A. | Tasmania | | | |
| Rev. W. R. WAUGH, F.R.A.S. | Portland | 4 | | |
| Rev. J. WEBSTER, M.A. | Tiverton | | | |
| A. STANLEY WILLIAMS, F.R.A.S. | Brighton | | | |
| Rev. L. A. WILLIAMS | Dorchester | | | |
| W. H. WOOSTER | Ballarat | | | |
| J. WYKES | Burnbook | | | |

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ed by Messrs. Antoniadi,
with the perpendicular has
in the interim paper on the
xcellent drawings showing
n. Capt. Wm. Noble, in an
a drawing, has suggested the
e appearances of the Jovian
forwarded to the Members of
data, but it is thought desirable
Memoir that a far wider area of
ffected, and in reading previous
(it may be of long anterior dates),
the Section will not overlook their
he matter being one of surpassing
at there should be an accumulation of
n the discussion of which it is hoped
ssistance will certainly be required.
the Members of specimen drawings in a
universal satisfaction. It will be resumed
sibly every Member will express a desire
their interest is certainly educational and
pity that any of the drawings should lie
brary facilities will be afforded for their

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Section. The more formal of these will be
second part of this Memoir.
Memoirs, Part I. is mainly preliminary. Part II.
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returns of some of the more active Members
notably that of Mr. Stanley Williams, to whom the
n deeply indebted. Part III. is devoted to satelline
department the importance of which demands far
returns than have heretofore been received, and to
special efforts will be made during the next apparition.
a brief review of the more prominent facts recorded



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We cannot, as a Section, allow the departure from his native land of Mr. N. E. Green to occur without expressing our deep regret, accompanied by an earnest hope that circumstances may permit his return at no distant date. It is only the commonest justice to say that for whatever of excellence in delineation the Section has attained the Members are largely indebted to his kindly instructions, so freely and fully given. There is, however, no fear of his ever being forgotten by the Jupiter Section, for his admirable disk forms are felt to be almost indispensable, and the more they are used the more they are appreciated.

As heretofore, the Members of the Section would record their indebtedness to Dr. Marth for his ephemerides, which have been far more freely used in the late observations than those of previous apparations, especially in determining the longitude of the central meridian of the drawings, nearly all the Members appending the longitudes of their own sketches. As in former seasons, the advice of Mr. Stanley Williams has been cordially given. Tables for computing longitude have also been furnished by Dr. Smart, and these his co-workers have found of great value. Others, both in and outside the Section, have in various ways assisted the work. Such assistance has materially lightened and brightened the labour of direction, and though the correspondence has sometimes been heavy it has never been felt a burden. The Director would strongly recommend inter-communication among Jovian students in and out of the Section, as an effective means of promoting activity and eliciting truth.

The micrometer has certainly been more freely used than on former occasions, Mr. MacEwen having greatly stimulated this important mode of operation by his example. It is hoped that the frequently urged advice of Dr. Downing as to accuracy of delineation will bear abundant fruit in future reports. It is quite believed that the discussions on a recent interim paper will materially aid in awakening the Members of the Section to the importance of accuracy in determining the latitudes of the markings. But skill in micrometrical work is largely a matter of the education of eye and hand, implying the exercise of patience, and the lapse of time. A high class micrometer is not within the cash margin that many amateurs have for such purposes. It is to be hoped that our instrument makers many see it worth their while to prepare a useful micrometer within a moderate cost. It is certainly a desideratum at the passing time, and would add much to the interest and value of planetary work, and probably fill up the vacancies in the ranks of our double star observers, for which fascinating work every amateur has predilections.

To the 47 Members of the Section the Director feels impelled to present his hearty thanks for the work they have accomplished. Of course in such a comprehensive expression there are some who hold a prominent position, and though it would be invidious to name them, it is quite unnecessary, for they are well known and honoured by their co-workers. It should be added the equality of the returns as to quantity and satisfactoriness is more marked than heretofore, not any one towering above the rest, the excellence being far more equally divided, though in the several features of



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accuracy, artistic beauty, and copiousness, there are some whom the concensus of opinion would place first.

The most interesting features of the planet during the apparition of 1893–4 are as follows: The gradual fading of the great red spot almost to invisibility. This is dealt with in the returns of Messrs. Cammell, MacEwen, Davis, Maw, Antoniadi, and others. It required very favourable seeing conditions to detect the spot. Some of its appearances will be dealt with in the fourth part.

By far the most prominent feature of the apparition has been the abnormal activity of the N. equatorial belt. This has been pretty fully dealt with in an interim report, printed on page 88 of the 4th volume of the "Journal"; subsequent features will be dealt with further on, though here it might be said that the later observations indicated some cessation of activity. The white markings on the south tropical zone have been more numerous than usual. White markings have also been noteworthy on the north tropical zone

The singular wisps on the equatorial zone have been prominent, and have been very successfully observed by Messrs. Antoniadi, Cammell, and Maw. Their angularity with the perpendicular has been marked, and has been referred to in the interim paper on the probable "Winds of Jupiter." The excellent drawings showing them are well worthy close attention. Capt. Wm. Noble, in an interesting letter, accompanied with a drawing, has suggested the possible cyclical character of some appearances of the Jovian markings. Instructions will be forwarded to the Members of Sections to observe for verifying data, but it is thought desirable to insert this suggestion in this Memoir that a far wider area of astronomical research may be affected, and in reading previous notices of planetary markings of (it may be of long anterior dates), it is hoped that the Members of the Section will not overlook their own antecedent memoirs. The matter being one of surpassing interest, it is to be desired that there should be an accumulation of data, historic and passing, in the discussion of which it is hoped Capt. Noble will assist, for assistance will certainly be required.

The circulation among the Members of specimen drawings in a miniature portfolio gave universal satisfaction. It will be resumed next apparition, when possibly every Member will express a desire to see the drawings, for their interest is certainly educational and instructive. It is a pity that any of the drawings should lie unnoted. Possibly library facilities will be afforded for their inspection and study.

There have been a few returns from Members of the Association not in the Section. The more formal of these will be referred to in the second part of this Memoir.

As in previous Memoirs, Part I. is mainly preliminary. Part II. is descriptive, in condensed forms, of the work of the Section, giving also the returns of some of the more active Members almost intact, notably that of Mr. Stanley Williams, to whom the Section is again deeply indebted. Part III. is devoted to satelline phenomena, a department the importance of which demands far more copious returns than have heretofore been received, and to secure such special efforts will be made during the next apparition. Part IV. is a brief review of the more prominent facts recorded



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by the Section. This and the previous reports may largely be regarded as a seed-sowing work, which it is earnestly hoped will produce in time to come an abundant harvest, for the effectual gathering of which the kindly aid of experts, professional and amateur, will be thankfully welcomed.

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## PART 2.

As many of the returns have reached the Director in "forms informal," such as letters and postcards, the work has been collective, and, to secure the required brevity, condensative.

As in the last Memoir the surface of the planet has been divided into six sections, each comprising 60° of longitude, that is, the distance each side of the central meridian will be about 30°, such arrangement fairly avoiding the distortion incident to curvature of surface. Reference to the previous Memoir will explain this more fully, where it is shown that the limit of 45° is pretty safe for comparison or measurement purposes. Of course this is true, *mutatis mutandis*, with reference to latitude. While speaking of latitude it may be well at once to say that the Members of Section are conscious that more care is necessary in time to come, and it is one of those matters in which the sketches will in future appear in an amended form. Two qualifying remarks are, however, needed; several of the draughtsmen have been as correct as the careful use of the micrometer or satisfactory eye estimates will permit. Also it is a recognised fact that some at least of the belts shift more or less slightly in latitude, notably the south temperate bands. The reason for this is one of the obscurities of Jupiter, to unravel which the efforts of the more curious of the Section will be directed. In the preparation of Table II. the whole of the drawings appended to this part have been utilised, 253 in number, except a few that have reached the Director, not intended for the Memoir. Thirty of the drawings have been selected for reproduction in the plates at the end of this report. If the selection had been based on the claims of excellence, a far larger number would appear, even special interest of features has not been entirely the guide, but in order that the Members might be encouraged in their work, as many as possible of the workers are represented in the plates. There are some, the whole of whose drawings have claim for publicity, but unfortunately financial reasons forbid such a course. If any think the disproportion between 253 and 30 is too great, the remedy is in the hands of the Association by each Member convassing for additional ones to secure the necessary funds.

The longitudes have been calculated by the use of Dr. Marth's tables, according to System II. of the Ephemeris published in the "Monthly Notices" of the Royal Astronomical Society (see the previous Memoir). Two different formulæ for this computation have been forwarded to each Member of the Section, and it is a gratifying feature of progress that the Director has had to bear less of the burden of computing longitudes than heretofore.



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## TABLE II.

List of Drawings made by Members of the Jupiter Section during the Apparition of 1893–4, arranged in order of Longitude.

| Longitude of Central Meridian. | Date of Drawing. | Time (G.M.T.) | Name of Observer. | Reference No. of Drawing. | Reference to Plates. |
|---|---|---|---|---|---|
| ° | | h m | | | |
| 0 | 1893, Dec. 22 | 10 27 | Cammell | 1 | |
| 0 | 1893, Dec. 1 | 8 10 | Waugh | 2 | Fig. 1 |
| 1 | 1893, Dec. 22 | 10 30 | Offord | 3 | |
| 1 | 1893, Oct. 4 | 10 30 | Cope | 4 | |
| 1 | 1893, Oct. 16 | 11 20 | Wykes | 5 | |
| 3 | 1893, Sept. 12 | 12 25 | Waugh | 6 | |
| 4 | 1893, Aug. 11 | 6 0 | MacEwen | 7 | |
| 5 | 1894, Mar. 24 | 7 0 | Smart | 8 | |
| 5 | 1893, Sept. 7 | 13 20 | MacEwen | 9 | Fig. 2 |
| 6 | 1893, Oct. 20 | 12 0 | Offord | 10 | |
| 8 | 1893, Oct. 4 | 10 40 | Davis | 11 | |
| 8 | 1894, Jan. 28 | 6 20 | G. L. Brown | 12 | |
| 8 | 1893, Aug. 25 | 13 30 | Buttemer | 13 | |
| 9 | 1893, Nov. 26 | 9 45 | Wykes | 14 | |
| 10 | 1893, Dec. 30 | 7 30 | Corder | 15 | |
| 12 | 1893, Dec. 1 | 8 30 | Davis | 16 | Fig. 3 |
| 12 | 1893, Sept. 22 | 10 55 | Davis | 17 | |
| 13 | 1894, Feb. 16 | 7 15 | Cammell | 19 | |
| 14 | 1893, Oct. 23 | 11 30 | Waugh | 20 | |
| 15 | 1893, Nov. 6 | 13 0 | MacEwen | 21 | |
| 16 | 1894, Mar. 24 | 7 15 | Davis | 22 | |
| 19 | 1893, Sept. 5 | 12 45 | Waugh | 23 | |
| 20 | 1893, Oct. 1 | 10 30 | Wykes | 24 | |
| 21 | 1893, Dec. 10 | 11 9 | Maw | 25 | |
| 22 | 1893, Sept. 24 | 12 50 | Antoniadi | 26 | |
| 24 | 1893, Oct. 26 | 9 15 | Evershed | 27 | |
| 24 | 1893, Dec. 23 | 7 0 | Waugh | 28 | |
| 25 | 1893, Dec. 3 | 10 20 | Mee | 29 | |
| 25 | 1893, Nov. 12 | 8 15 | Cammell | 30 | Fig. 4 |
| 26 | 1893, Nov. 7 | 9 10 | Cammell | 31 | |
| 26 | 1893, Sept. 27 | 10 25 | Davis | 32 | |
| 27 | 1893, Oct. 20 | 14 20 | Antoniadi | 33 | Fig. 5 |
| 28 | 1893, Aug. 12 | 12 30 | Wykes | 34 | |
| 34 | 1894, Mar. 2 | 9 26 | Davis | 35 | |
| 37 | 1893, Dec. 22 | 9 0 | Ellis | 36 | |
| 38 | 1894, Jan. 23 | 8 0 | Offord | 37 | Fig. 6 |
| 38 | 1893, Dec. 9 | 5 50 | Waugh | 38 | |
| 39 | 1893, Oct. 23 | 12 10 | Foulkes | 39 | |
| 43 | 1893, Sept. 15 | 10 50 | Davis | 40 | |
| 43 | 1893, Dec. 23 | 7 30 | Goodacre | 41 | |
| 45 | 1893, Aug. 19 | 13 45 | Buttemer | 42 | |
| 46 | 1894, Mar. 17 | 7 15 | Davis | 43 | |
| 48 | 1893, Dec. 1 | 9 30 | L. A. Williams | 44 | Fig. 7 |
| 48 | 1893, Dec. 1 | 9 30 | Ryle | 45 | |
| 48 | 1893, Dec. 1 | 9 30 | Ellis | 46 | |
| 49 | 1894, Jan. 30 | 8 15 | Davis | 47 | |
| 54 | 1893, Sept. 4 | 14 45 | Cope | 48 | Fig 8 |



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| Longitude of Central Meridian. | Date of Drawing. | Time (G.M.T.) | Name of Observer. | Reference No. of Drawing. | Reference to Plates. |
|---|---|---|---|---|---|
| ° | | h m | | | |
| 56 | 1893, Oct. 24 - | 8 30 | Davis - - | 49 | |
| 57 | 1893, Sept. 4 - | 13 10 | Waugh - | 50 | |
| 57 | 1894, Jan. 1 - | 10 15 | Cope - - | 51 | |
| 57 | 1893, Nov. 7 - | 10 0 | Davis - - | 52 | |
| 62 | 1893, Oct. 21 - | 11 10 | MacEwen - | 53 | |
| 65 | 1893, Oct. 31 - | 9 30 | Mee - - | 54 | |
| 66 | 1893, Nov. 17 - | 8 30 | Mee - - | 55 | Fig. 9 |
| 66 | 1893, Nov. 17 - | 8 30 | Wykes - | 56 | |
| 67 | 1893, Sept. 15 - | 11 40 | Cammell - | 57 | |
| 69 | 1893, Oct. 31 - | 9 35 | Cammell - | 58 | Fig. 10 |
| 69 | 1893, Oct. 31 - | 9 35 | Davis - - | 59 | |
| 71 | 1893, Dec. 16 - | 7 30 | L. A. Williams - | 60 | |
| 71 | 1893, Dec. 16 - | 7 30 | Waugh - | 61 | |
| 72 | 1893, Dec. 23 - | 8 30 | Mee - - | 62 | |
| 73 | 1893, Dec. 30 - | 9 5 | Goodacre - | 63 | Fig. 11 |
| 74 | 1893, Oct. 31 - | 9 45 | Ellis - - | 64 | |
| 78 | 1893, Oct. 31 - | 10 10 | Maw - - | 65 | |
| 79 | 1893, Oct. 10 - | 10 0 | Waugh - | 66 | |
| 80 | 1893, Nov. 22 - | 8 0 | Waugh - | 67 | Fig. 12 |
| 83 | 1894, Feb. 22 - | 8 10 | Waugh - | 68 | |
| 84 | 1893, Oct. 31 - | 10 0 | L. A. Williams - | 69 | |
| 85 | 1893, Sept. 15 - | 12 10 | MacEwen - | 70 | |
| 87 | 1893, Dec. 30 - | 8 30 | Ryle - - | 71 | |
| 93 | 1893, Oct. 31 - | 10 15 | Waugh - | 72 | |
| 93 | 1893, Nov. 17 - | 9 15 | Ellis - - | 73 | |
| 94 | 1893, Oct. 12 - | 11 20 | Antoniadi - | 74 | |
| 96 | 1893, Oct. 24 - | 9 36 | Antoniadi - | 75 | |
| 96 | 1893, Oct. 31 - | 10 10 | Davis - - | 76 | |
| 97 | 1893, Sept. 24 - | 14 50 | Antoniadi - | 77 | |
| 97 | 1893, Dec. 23 - | 9 0 | Ellis - - | 78 | |
| 100 | 1894, Mar. 29 - | 8 45 | Waugh - | 79 | |
| 102 | 1893, Sept. 30 - | 10 0 | Wykes - - | 80 | |
| 102 | 1893, Sept. 30 - | 10 0 | Ellis - - | 81 | |
| 102 | 1893, Sept. 30 - | 10 0 | Corder - - | 82 | |
| 108 | 1893, Dec. 2 - | 7 0 | Mee - - | 83 | |
| 108 | 1893, Oct. 31 - | 10 40 | Cope - - | 84 | |
| 110 | 1893, Nov. 22 - | 8 50 | Ellis - - | 85 | |
| 111 | 1893, Sept. 9 - | 10 15 | Smart - - | 86 | Fig. 13 |
| 111 | 1893, Oct. 29 - | 9 0 | Mee - - | 87 | |
| 111 | 1893, Oct. 24 - | 10 0 | Davis - - | 88 | |
| 114 | 1893, Sept. 30 - | 10 20 | Davis - - | 89 | |
| 115 | 1893, Oct. 19 - | 11 0 | Cope - - | 90 | |
| 115 | 1893, Sept. 15 - | 13 0 | MacEwen - | 91 | |
| 117 | 1893, Oct. 31 - | 10 55 | Cammell - | 92 | |
| 118 | 1893, Aug. 12 - | 15 0 | MacEwen - | 93 | |
| 118 | 1893, Dec. 23 - | 9 35 | Maw - - | 94 | Fig. 14 |
| 119 | 1893, Dec. 9 - | 8 5 | Davis - - | 95 | |
| 119 | 1893, Nov. 12 - | 10 50 | Maw - - | 96 | |
| 120 | 1893, Oct. 31 - | 10 50 | Evershed - | 97 | |
| 120 | 1893, Oct. 31 - | 11 0 | Goodacre - | 98 | |
| 121 | 1893, Oct. 19 - | 10 55 | Antoniadi - | 99 | Fig. 15 |
| 121 | 1893, Dec. 23 - | 9 40 | Offord - | 100 | |
| 122 | 1893, Nov. 22 - | 9 0 | Wykes - | 101 | |
| 122 | 1894, Mar. 31 - | 6 50 | G. L. Brown - | 102 | |



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| Longitude of Central Meridian. | Date of Drawing. | Time (G.M.T.) | Name of Observer. | Reference No. of Drawing. | Reference to Plates. |
|---|---|---|---|---|---|
| | | h m | | | |
| 123° | 1894, Mar. 27 | 7 30 | Davis | 103 | |
| 124 | 1893, Dec. 11 | 9 50 | Offord | 104 | |
| 128 | 1894, April 1 | 7 0 | G. L. Brown | 105 | |
| 129 | 1893, Sept. 30 | 10 45 | Cope | 106 | |
| 134 | 1893, Nov. 22 | 9 30 | Offord | 107 | |
| 137 | 1894, Feb. 19 | 8 0 | Waugh | 108 | |
| 137 | 1894, Jan. 12 | 6 40 | Ryle | 109 | |
| 138 | 1893, Oct. 31 | 11 30 | Offord | 110 | |
| 138 | 1893, Nov. 22 | 9 35 | Maw | 111 | |
| 140 | 1893, Nov. 5 | 10 40 | Goodacre | 112 | |
| 142 | 1893, Dec. 23 | 10 14 | Maw | 113 | Fig. 16 |
| 142 | 1893, Dec. 11 | 10 20 | Davis | 114 | |
| 143 | 1893, Dec. 9 | 10 45 | Goodacre | 115 | |
| 143 | 1893, Oct. 10 | 10 45 | Ellis | 116 | |
| 144 | 1893, Dec. 16 | 9 30 | Offord | 116a | |
| 144 | 1893, Oct. 7 | 11 0 | Waugh | 117 | |
| 144 | 1893, Oct. 31 | 10 45 | Foulkes | 118 | Fig. 17 |
| 145 | 1893, Nov. 22 | 9 45 | Corder | 119 | |
| 147 | 1893, Sept. 30 | 11 15 | Mee | 120 | |
| 147 | 1893, Sept. 30 | 11 15 | Cammell | 121 | |
| 147 | 1893, Dec. 2 | 8 5 | Davis | 122 | |
| 149 | 1893, Dec. 9 | 9 0 | Foulkes | 123 | |
| 152 | 1893, Oct. 5 | 10 30 | Cope | 124 | |
| 156 | 1894, Mar. 25 | 7 0 | Wykes | 125 | Fig. 18 |
| 158 | 1893, Nov. 5 | 11 10 | Cammell | 126 | |
| 158 | 1893, Dec. 23 | 10 40 | Goodacre | 127 | |
| 164 | 1893, Oct. 22 | 9 50 | Cope | 128 | |
| 167 | 1894, Mar. 11 | 5 40 | Essam | 129 | |
| 168 | 1893, Dec. 16 | 10 10 | Cammell | 130 | |
| 169 | 1893, Oct. 20 | 8 20 | Antoniadi | 131 | |
| 170 | 1893, Oct. 22 | 10 0 | Foulkes | 132 | |
| 171 | 1893, Nov. 5 | 11 30 | Buttemer | 133 | |
| 172 | 1893, Dec. 2 | 8 45 | Ellis | 134 | |
| 176 | 1893, Aug. 15 | 11 5 | Buttemer | 135 | |
| 176 | 1894, Feb. 3 | 6 0 | Corder | 136 | |
| 176 | 1894, Feb. 3 | 6 0 | Corder | 137 | |
| 179 | 1893, Oct. 29 | 11 0 | MacEwen | 138 | |
| 182 | 1893, Oct. 19 | 12 50 | Antoniadi | 138a | |
| 185 | 1893, Dec. 7 | 8 15 | Wykes | 139 | |
| 190 | 1893, Sept. 21 | 10 0 | Wykes | 140 | |
| 194 | 1894, Feb. 12 | 8 55 | Davis | 141 | |
| 194 | 1893, Dec. 29 | 6 40 | Cammell | 142 | Fig. 19 |
| 194 | 1893, Dec. 29 | 6 40 | Cammell | 143 | |
| 194 | 1893, Oct. 29 | 14 50 | Antoniadi | 144 | |
| 195 | 1893, Oct. 22 | 10 40 | Maw | 145 | |
| 196 | 1893, Dec. 29 | 6 45 | Ryle | 146 | |
| 199 | 1893, Dec. 8 | 7 15 | L. A. Williams | 147 | |
| 200 | 1893, Dec. 7 | 8 40 | Smart | 148 | |
| 201 | 1893, Dec. 9 | 10 20 | Offord | 149 | |
| 201 | 1893, Nov. 15 | 10 35 | Cammell | 150 | |
| 202 | 1893, Nov. 22 | 8 35 | Evershed | 151 | |
| 203 | 1893, Nov. 6 | 8 15 | Mee | 152 | |
| 205 | 1893, Oct. 20 | 9 20 | Antoniadi | 153 | Fig. 20 |
| 208 | 1893, Dec. 12 | 8 0 | Mee | 154 | |



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| Longitude of Central Meridian. | Date of Drawing. | Time (G.M.T.) | Name of Observer. | Reference No. of Drawing. | Reference to Plates. |
|---|---|---|---|---|---|
| ° | | h m | | | |
| 209 | 1893, Oct. 8 | 9 35 | Cammell | 155 | |
| 211 | 1893, Dec. 2 | 9 50 | Cammell | 156 | |
| 212 | 1893, Nov. 20 | 10 0 | MacEwen | 157 | |
| 212 | 1893, Oct. 27 | 10 15 | Davis | 158 | |
| 212 | 1894, Feb. 27 | 6 55 | Cammell | 159 | |
| 217 | 1893, Dec. 2 | 10 0 | Ryle | 160 | Fig. 21 |
| 217 | 1893, Oct. 3 | 10 40 | Mee | 161 | |
| 218 | 1893, Oct. 22 | 11 20 | MacEwen | 162 | |
| 218 | 1894, Mar. 4 | 16 15 | G. L. Brown | 163 | |
| 219 | 1893, Dec. 16 | 11 36 | Maw | 164 | Fig. 22 |
| 220 | 1893, Feb. 20 | 6 20 | Cammell | 165 | |
| 221 | 1893, Dec. 14 | 10 0 | Foulkes | 166 | |
| 225 | 1893, Nov. 13 | 9 37 | Cammell | 167 | |
| 229 | 1894, Jan. 17 | 8 20 | Corder | 168 | Fig. 23 |
| 230 | 1893, Nov. 23 | 10 45 | L. A. Williams | 169 | |
| 231 | 1893, Aug. 13 | 14 0 | Corder | 170 | |
| 232 | 1893, Oct. 8 | 10 40 | Mee | 171 | |
| 235 | 1893, Sept. 26 | 10 25 | Smart | 172 | |
| 237 | 1893, Dec. 7 | 9 40 | Offord | 173 | |
| 240 | 1894, Jan. 31 | 10 15 | Essam | 174 | |
| 241 | 1893, Oct. 20 | 10 20 | Antoniadi | 175 | |
| 242 | 1893, Nov. 13 | 10 5 | Davis | 176 | |
| 242 | 1893, Oct. 27 | 11 5 | Maw | 177 | |
| 243 | 1893, Nov. 8 | 11 0 | MacEwen | 178 | |
| 244 | 1893, Dec. 12 | 9 0 | Wykes | 179 | |
| 248 | 1893, Dec. 10 | 7 30 | Mee | 180 | |
| 248 | 1894, Mar. 4 | 7 5 | Maw | 181 | |
| 252 | 1893, Dec. 19 | 10 0 | Foulkes | 182 | |
| 255 | 1893, Oct. 20 | 12 20 | Antoniadi | 183 | Fig. 24 |
| 256 | 1893, Nov. 11 | 8 50 | Mee | 184 | |
| 257 | 1894, Feb. 22 | 9 0 | Davis | 185 | |
| 258 | 1893, Oct. 8 | 10 55 | Maw | 186 | |
| 260 | 1893, Nov. 12 | 10 20 | Ellis | 187 | |
| 260 | 1893, Nov. 5 | 10 0 | Mee | 188 | |
| 262 | 1894, Feb. 18 | 5 50 | Cammell | 189 | Fig. 25 |
| 266 | 1893, Oct. 10 | 9 0 | Foulkes | 190 | |
| 266 | 1893, Oct. 30 | 9 15 | Ellis | 191 | |
| 267 | 1893, Aug. 23 | 13 10 | Waugh | 192 | |
| 267 | 1893, Oct. 1 | 10 25 | Mee | 193 | |
| 270 | 1893, Oct. 18 | 9 30 | Foulkes | 194 | |
| 270 | 1893, Nov. 6 | 10 5 | Davis | 195 | |
| 270 | 1893, Oct. 18 | 9 30 | Cammell | 196 | |
| 270 | 1893, Oct. 8 | 11 15 | Cammell | 197 | |
| 279 | 1893, Oct. 1 | 10 50 | Foulkes | 198 | |
| 279 | 1893, Dec. 29 | 9 0 | Ellis | 199 | |
| 286 | 1894, April 20 | 7 55 | G. L. Brown | 200 | |
| 287 | 1894, Jan. 11 | 5 0 | Wykes | 201 | |
| 288 | 1893, Dec. 25 | 6 0 | Foulkes' | 202 | |
| 289 | 1893, Dec. 22 | 8 30 | Mee | 203 | |
| 290 | 1893, Nov. 23 | 8 0 | Waugh | 204 | |
| 290 | 1893, Oct. 30 | 9 55 | Davis | 205 | |
| 292 | 1894, Jan. 3 | 8 30 | Mee | 206 | |
| 294 | 1894, Jan. 1 | 6 55 | Cammell | 207 | |
| 298 | 1893, Dec. 15 | 8 0 | Mee | 208 | Fig. 26 |



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| Longitude of Central Meridian. | Date of Drawing. | Time (G.M.T.) | Name of Observer. | Reference No. of Drawing. | Reference to Plates. |
|---|---|---|---|---|---|
| ° | | h m | | | |
| 299 | 1893, Dec. 2 | 9 30 | Mee | 209 | |
| 300 | 1893, Oct. 18 | 10 10 | Davis | 210 | |
| 302 | 1893, Oct. 30 | 10 15 | Cammell | 211 | |
| 303 | 1893, Nov. 6 | 11 0 | Offord | 212 | |
| 303 | 1893, Nov. 6 | 11 0 | Goodacre | 213 | |
| 303 | 1893, Dec. 29 | 9 40 | Cammell | 214 | Fig. 27 |
| 304 | 1893, Nov. 23 | 6 0 | Wykes | 215 | |
| 305 | 1893, Oct. 30 | 10 20 | Mee | 216 | |
| 306 | 1893, Oct. 18 | 10 30 | Waugh | 217 | |
| 307 | 1893, Oct. 22 | 9 0 | Ryle | 218 | |
| 307 | 1893, Dec. 23 | 9 0 | Cammell | 219 | |
| 307 | 1893, Oct. 26 | 10 0 | Ellis | 220 | |
| 311 | 1893, Oct. 30 | 10 30 | Waugh | 221 | |
| 312 | 1893, Dec. 28 | 5 0 | Goodacre | 222 | |
| 315 | 1893, Oct. 30 | 10 35 | Maw | 223 | |
| 316 | 1893, Dec. 22 | 9 15 | Offord | 224 | |
| 316 | 1894, Feb. 8 | 9 0 | Offord | 225 | |
| 317 | 1893, Nov. 11 | 10 30 | Goodacre | 226 | |
| 321 | 1894, Jan. 1 | 7 40 | Wykes | 227 | |
| 323 | 1893, Nov. 11 | 10 40 | Evershed | 228 | Fig. 28 |
| 324 | 1893, Dec. 23 | 5 20 | Waugh | 229 | Fig. 29 |
| 324 | 1893, Oct. 1 | 12 0 | Cammell | 230 | |
| 326 | 1893, Nov. 6 | 11 40 | MacEwen | 231 | |
| 326 | 1893, Dec. 11 | 5 30 | Wykes | 232 | |
| 326 | 1893, Nov. 11 | 10 45 | Davis | 233 | |
| 331 | 1893, Aug. 14 | 12 35 | Waugh | 234 | |
| 339 | 1893, Nov. 9 | 9 30 | Mee | 235 | |
| 343 | 1893, Oct. 18 | 11 30 | Ryle | 236 | |
| 343 | 1893, Dec. 22 | 10 0 | Ryle | 237 | |
| 347 | 1894, Feb. 8 | 7 10 | Corder | 238 | |
| 349 | 1893, Oct. 11 | 10 45 | Mee | 239 | |
| 349 | 1893, Oct. 7 | 17 30 | Corder | 240 | |
| 349 | 1893, Oct. 13 | 11 40 | Cammell | 241 | |
| 350 | 1893, Dec. 22 | 10 15 | Mee | 242 | |
| 350 | 1893, Nov. 7 | 8 20 | Mee | 243 | |
| 350 | 1893, Oct. 20 | 13 20 | Antoniadi | 244 | Fig. 30 |
| 352 | 1893, Nov. 23 | 11 20 | Offord | 245 | |
| 360 | 1893, Nov. 26 | 9 0 | Corder | 246 | |
| | SUPPLEMENTARY SKETCHES.* | | | | |
| | 1894, Jan. 20 | 4 30 | G. L. Brown | 247 | |
| | 1894, Feb. 3 | 7 50 | Mee | 248 | |
| | 1894, Feb. 3 | 9 35 | Mee | 249 | |
| | 1894, Feb. 18 | 6 0 | Mee | 250 | |
| | 1894, Mar. 4 | 6 30 | Mee | 251 | |
| | 1894, Mar. 6 | 7 30 | Mee | 252 | |

* These are interesting as of late date.

In the above list the range is from August 11, 1893, to April 20, 1894.



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The arrangement we shall adopt in dealing with these drawings is identical with that of the last Memoir, which gave general satisfaction, and which seems to secure the advantage of noting important detail with the necessary condensation. It consists of dividing the 360° of longitude into six equal sections—the notes on these sections being followed by others giving more detailed descriptions of the drawings selected for reproduction.

If the space available had not been strictly limited, the returns of many other observers would have been included, as their interest and clearness deserved it.

*Section I., longitude* 0° *to* 60°.—There are 51 drawings in this Section. In accordance with preliminary remarks on page 133 of the Second Memoir, this section of Jupiter's surface may be considered as fully shown by drawings having central meridians from 15° to 45°, and as partially shown by drawings of which the central meridians vary from 345° to 15° and 45° to 75°. A reference to Table II. will show that 22 drawings are wholly available for comparison, making, of course, allowance for diversities of dates, of apertures, and powers used, and of those idiosyncrasies of draughtmanship which must always characterise a body of amateurs. Fifteen of these drawings show more or less distinctly the Great Red Spot, in some cases to the limit of visibility. In no case is it shown near the limb, as in the last Memoir. In one drawing its ringed aspect is clearly seen. The shoulder is plainly shown in nearly all the drawings, though its angle with the belt varies considerably, a variation thought by some to be a real change. In some instances it shows a sharp curvature, in others it declines towards horizontality very gradually. Its darkening western edge is also shown in several of the drawings. In six of the drawings the faint equatorial belt is just shown, indicating high-class seeing on these occasions. The flocculent aspect of the equatorial zone is shown in some of the sketches, and in many of them white markings are drawn. Dark and light spots are seen in nearly all the drawings; also the disturbed character of the N. equatorial belt, especially in those of later date. A striking instance of this feature is seen in drawings Nos. 16 (Fig. 3, Plate I.), 19, 20, and 33 (Fig. 5, Plate I.); *vide* "Journal," Vol. IV., page 88.

*Section II., longitude* 60° *to* 120°.—Comprising 46 drawings. This Section is shown fully by twenty drawings. The longitudinal rift in the S. equatorial belt is more or less clearly seen in 18 drawings, but it should be remarked there are few features more influenced by atmospheric conditions than this. The disturbed condition of the N. equatorial belt is indicated in thirty-eight of the sketches, Nos. 53, 56, 58 (Fig. 10, Plate I.), 60, 62, 65, 74, 75, 80, 86 (Fig. 13, Plate I.), 90, 96, showing it very distinctly. The faint equatorial belt, probably the most severe test on the disk, is just shown in drawings by Messrs. Antoniadi, Cammell, MacEwen, Maw, and Wykes. White markings, more or less definite, are shown in most of the drawings, specimens of which are well given in drawings Nos. 70, 75, 94 (Fig. 14, Plate I.), and 95. Wisps on the equatorial zone invariably with an eastern trend, and frequently



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extending from the N. edge of the S. equatorial belt to the S. edge of the N. equatorial belt are shown in drawings Nos. 58 (Fig. 10, Plate I.), 75, 77, 90, 92, 94 (Fig. 14, Plate I.). This feature vies as a delicate test of good seeing conditions with the faint equatorial belt.

*Section III., longitude* 120° *to* 180°.—Comprising forty-one drawings. This Section is completely shown by twenty-two sketches. The faint equatorial belt is shown in ten sketches, but in most instances considerably broken up. The wisps on the equatorial zone are well shown in three drawings; less perfectly in a few others; white spots and markings on the same zone in eight sketches. It is noteworthy that some observers seem to have a special aptitude for decerning these delicate markings; they may be regarded as a test of good personal vision. Dark spots, in some cases well defined, are shown in ten drawings on the N. edge of the S. equatorial and on the S. edge of the N. equatorial belts. The latter are the more numerous and prominent, being, in fact, a feature of the great disturbance in that belt, shown more or less in nearly all the drawings of this Section. We might instance those of Messrs. Antoniadi and Maw, numbered respectively 99 (Fig. 15, Plate I.) and 111. The longitudinal rift in the S. equatorial belt is shown in eleven drawings. Messrs. Offord and Goodacre clearly caught it, the latter depicting it angularly in No. 112. There are two sketches by Mr. Offord at the same date and hour. On the presumption that they are not copies of each other, they show that great care must have been taken in delineation, allowing for a necessary small interval of time and a slight diversity of seeing.

*Section IV., longitude* 180° *to* 240°.—Comprising thirty-six drawings. This Section is completely represented in twenty-three sketches. The faint equatorial belt is shown in twelve drawings, though partially and faintly in most cases. This test object seems to be better seen in its preceding portion. This is probably an optical result, and may be guarded against, at least in some measure. The curious wisps on the equatorial zone are only fairly shown on three drawings. In a few others they are rather suggested than depicted. Spots or dark protuberances on the edges toward the equator are shown in nearly all the drawings. Very distinct instances are seen in drawings Nos. 138, 144, 145, 147, 153 (Fig. 20, Plate II.), 154, 156, 158, 168 (Fig. 23, Plate II.). Light adjacent spots also abound. Mr. Mee in drawing No. 152 shows four light spots on the N. equatorial belt. They are also very marked in a drawing by M. Antoniadi, No. 153 (Fig. 20, Plate II.), and on the S. equatorial belt Mr. Maw shows four very prominent light spots, with three others on the S. temperate bands. The latter position is not unusual. A very unusual dark marking, considerably elongated, is shown by Rev. T. H. Foulkes in drawing No. 166. Mr. Maw corroborates this in No. 164 (Fig. 22, Plate II.), two days later; it is possibly also corroborated by Messrs. Cammell and Mee, Nos. 154 and 156. The disturbances in the N. equatorial belt are shown in this Section in twenty-five drawings; prominently in drawings No. 147 by Rev. L. A. Williams, in No. 149 by Mr. Offord,



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and by Mr. Cammell in No. 159. A prominent white spot is shown by Mr. Wykes in drawing No. 139 on the N. tropical zone.

*Section V., longitude* 240° *to* 300°.—Comprising thirty-six drawings. In this Section complete views are given by seventeen drawings. The faint equatorial belt is shown in six sketches, but it is very indistinctly drawn in all but one. The evanescent wisps on three only. White markings in the equatorial zone on seven, several very faintly, notably on sketches by Messrs. Mee, Cammell, Davis, and Antoniadi. Dark and light spots on the N. edge of the S. equatorial and the S. edge of the N. equatorial belts abound. They are very marked on the drawings of Messrs. Antoniadi, Maw, MacEwen, Foulkes, Davis, and Mee. Nearly all the drawings in this Section show the disturbed condition of the N. equatorial belt. The drawing, No. 199, by Mr. Ellis, shows it in a very unusual form. The S.S. temperate band is shown prominently on sketches Nos. 178, 181, 188, 189 (Fig. 25, Plate II.), 197, 200, 205, 206, and 210. In the same region white spots are frequently shown; Messrs. Antoniadi, Mee, Cammell, and Ellis depict them prominently.

*Section VI., longitude* 300° *to* 360°.—Comprising thirty-six drawings, fifteen of which exhibit the section completely. The faint equatorial belt is distinctly shown in two sketches. The equatorial wisps are shown in the drawings by Messrs. Cammell, Goodacre, and Antoniadi, especially by the latter when using M. Flammarion's telescope at Juvissy. The equatorial zone light markings are seen in drawings Nos. 211, 214 (Fig. 27, Plate II.), 216, 219, 221, 226, 235, 242, and 243. The shoulder following the Great Red Spot is strongly depicted by Mr. Corder in drawing No. 246, and it appears of an unusual form. The shadowy aspect of the fast-fading Great Red Spot is seen in several of the sketches, notably in No. 244 (Fig. 30, Plate II.). The disturbances in the N. equatorial belt are well shown by Dr. Ryle, Messrs. Evershed, Corder, Offord, Cammell, Mee, Ellis, Maw, Goodacre, MacEwen, and Wykes.

The division in the equatorial belts is shown in Nos. 213, 216, 217, 219, 221, 224, 225, 231—very marked here in the N. belt, unusual—238, 229, 240, 244. (Fig. 30, Plate II.) and 246; in 244 as preceding and following the Great Red Spot. Disturbances in the N. equatorial belt are shown in most of the sketches, we might instance those of Messrs. Evershed, Corder, and Antoniadi as unusual and marked. Light spots are shown in both tropical zones in several of the drawings, and are prominent in Nos. 211, 214, (Fig. 27, Plate II), 219, 232, and 242. It seems a special facility with some observers to discern these delicate markings.

The supplementary drawings, though interesting, do not claim special remark. Being on plain unprepared card, they do not favour comparison with the others; moreover, the scale is different. They, however, help to show the advantages by comparison of Mr. Green's disks.

The following brief descriptions of 30 drawings, from which the reproductions in the plates accompanying this Memoir are taken, will give some idea of the general character of the sketches



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returned. The descriptions are taken as far as possible from those furnished by the Members.

*Fig.* 1 (*Waugh*).—The following edge of the great red spot is shown. Also the shoulder very plainly, and the duplicity of that portion of the belt following it. The faint equatorial belt is shown somewhat broken up. The N. equatorial belt is shown duplex, with dark markings on its N. edge. The ringed aspect of the N. polar region is shown.

*Fig.* 2 (*MacEwen*).—The faint equatorial belt just seen. The duplicity in the S. and N. equatorial belts shown. The duplicity of the N. temperate band just seen. The light spots north and south of this belt are interesting.

*Fig.* 3 (*Davis*).—The position of the great red spot indicated by shading. The preceding edge of the shoulder dark, following which duplicity is shown. White markings are represented on the equatorial zone. The disturbances in the N. equatorial belt are well shown, and consist of protuberances on the S. edge on the following portion, and white markings on the N. edge of the preceding part. The S. temperate band very plainly shown.

*Fig.* 4 (*Cammell*).—The great red spot shown, as usual, the following portion most plainly. Duplicity of the S. equatorial belt well shown. The faint equatorial belt well shown, also the faint wisps, in one instance proceeding from belt to belt. The disturbances in the N. equatorial belt well shown. The S.S. temperate band shown. Both polar regions dark.

*Fig* 5 (*Antoniadi*).—The great red spot plainly shown. Also the duplicity of the S. equatorial belt, dark spots on its N. edge with the slight wisps proceeding from them to the S. edge of the N. equatorial belt. The disturbances in this latter belt very marked, and presenting a somewhat unique form. The N.N. temperate band shown.

*Fig.* 6 (*Offord*).—Duplicity shown in both equatorial belts. The mottled aspect of the equatorial zone shown. The S.S. and N.N. temperate bands shown.

*Fig.* 7 (*L. A. Williams*).—The duplex aspect of the S. equatorial belt shown. The disturbances in the N. equatorial belt well shown, consisting of irregularities and spots, also markings on the S. temperate band.

*Fig.* 8 (*Cope*).—Dark spots on the N. edge of the S. equatorial belts with wisps proceeding therefrom.

*Fig.* 9 (*Mee*).—Mottled aspect of the equatorial zone. The preceding portion of the S. equatorial belt dark. Two dark and large markings on the N. equatorial belt.

*Fig.* 10 *Cammell*).—Faint equatorial belt well shown, also one very broad wisp proceeding as usual from spots on the equatorial belts. The disturbances in the N. equatorial belt very plainly seen, and of special interest, showing dark and light markings. The N. temperate band dark and definite. The polar regions unusually dark.



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*Fig.* 11 (*Goodacre*). — The disturbed aspect of the N. equatorial belt seen, also dark markings on the S. equatorial belt. A light spot on the S. temperate band.

*Fig.* 12 (*Waugh*).—The faint equatorial belt just seen. Duplicity shown in the S. equatorial belt, also light spots on its N. edge. The disturbed aspect of the N. equatorial belt very plainly shown. The S. and S.S. and the N. and N.N. temperate bands shown. Three light spots on the S. temperate zone.

*Fig.* 13 (*Smart*).—Looped appearances on the N. edge of the S. equatorial belt shown with a dark protuberance between the loops. The N. equatorial belt duplex, and with distinct spots on the northern portion. The S. temperate band shown duplex, with a dark spot on it. The N. temperate band very marked.

*Fig.* 14 (*Maw*).—The faint equatorial belt shown, a wisp on the zone from belt to belt. Protuberances shown on the N. and S. edges of the equatorial belts, and other dark and light markings, especially a light spot on the following part of the S. equatorial belt. The N.N. temperate band duplex.

*Fig.* 15 (*Antoniadi*).—Showing the faint equatorial belt. Five wisps, three of which reach from belt to belt. Also 14 dark spots on the edges of the two belts. The S. equatorial is shown duplex and the N. much disturbed, the disturbance taking the form of a separate belt with seven dark spots on it, probably more less distinctly shown. The S. temperate band is curiously bent.

*Fig.* 16 (*Maw*).—Equatorial belt shown with three wisps from belt to belt proceeding from and to dark spots. The S. equatorial belt divided, two light spots being on the division line. The N. equatorial belt much disturbed at both edges. The N. temperate band dark. The N.N. temperate band just shown.

*Fig.* 17 (*Foulkes*).—The S. equatorial belt edged with a dark line. Also the N. equatorial belt with dark markings on the N. tropical zone.

*Fig.* 18 (*Wykes*).—A wisp on the equatorial zone from belt to belt. The N. edge of the S. equatorial belt serrated. The N. equatorial belt with curved markings on the S. edge. The N. and S. temperate bands dark.

*Fig.* 19 (*Cammell*).—Showing the equatorial belt and wisps, also dark markings on the S. equatorial belt and its duplicity. The N. equatorial belt much disturbed, especially on the S. edge. The S.S. and the N.N. temperate bands shown.

*Fig.* 20 (*Antoniadi*).—Three of the equatorial wisps shown with a westerly trend—a very unusual, almost unique, case. The duplicity of the S. equatorial belt shown. Four dark spots as sources of the wisps on the N. edge, also four light ones. The N. equatorial showing quite an array of light and dark spots, 17 in number, several very prominent.



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*Fig.* 21 (*Ryle*).—The equatorial zone shown mottled. The two equatorial belts duplex, with dark streaks on the N. edge of the S. one, also a dark diffused marking on the N. tropical zone extending to the N. temperate band, which is shown very slender, and of a bluish tone, not unusual in this band.

*Fig.* 22 (*Maw*).—The preceding portion of the faint equatorial belt seen. Dark markings on the N. and S. edges of the S. and N. equatorial belts. Four white spots on the S. equatorial and two white spots and a white streak on the N. one. Three white spots on the S. tropical zone. The S.S. temperate band seen. Also two slender belts far in the N. region.

*Fig.* 23 (*Corder*).—The S. equatorial belt duplex. The N. one much disturbed, with seven pointed projections on its N. and S. edges. Also light markings between on N. side. The S.S. temperate belt shown.

*Fig.* 24 (*Antoniadi*).—The following portion of the great red spot shown near the east limb. The shoulder plain. The early date should be noted. The preceding part of the belt duplex; wisps on the equatorial zone from belt to belt, with an easterly trend. The N. equatorial belt much disturbed, with six dark and three large light spots, one of the former having a curious elongation across the belt, and extending into the N. tropical zone. Two light spots on the S. temperate band.

*Fig.* 25 (*Cammell*).—One wisp shown on the equatorial zone. Both equatorial belts duplex, the S. having two dark extensions N. The N. edge of the N. belt has five prominent ones with white spots between reaching to the N. temperate band, a common appearance during the apparition. The S.S. temperate band seen.

*Fig.* 26 (*Mee*).—White markings and portion of the faint belt shown on the equatorial zone. The forked aspect of the N. equatorial belt shown with a dark irregular line on the N. edge. The N. equatorial belt much disturbed; curious dark markings shown. Three light spots on the S. temperate zone.

*Fig.* 27 (*Cammell*).—Wispy matter on the equatorial zone. Both equatorial belts shown duplex. Both disturbed, the N. by six or seven dark spots, one in the following portion being a light one, ringed with a dark line, somewhat akin to the light pair on Fig. 46. Four white spots on the S. temperate zone. The S.S. temperate band shown. A bluish slender band N. of the N. temperate one; colouring in this drawing very beautiful.

*Fig.* 28 (*Evershed*).—Spots on the equatorial zone. The N. equatorial belt rifted from the N., being probably a light spot lying over part of the belt. This belt shown disturbed. The S.S. temperate band just shown.



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*Fig.* 29 (*Waugh*).—The light equatorial belt just seen; also the Great Red Spot barely seen. The N. edge of the S. equatorial belt with ill-defined bridge-like formation. The N. equatorial belt much disturbed. Two prominent white spots on its preceding portion. Both polar regions ringed.

*Fig.* 30 (*Antoniadi*).—The great red spot plainly shown with the aureola. The wisps well seen, each with an easterly trend, and proceeding from dark spots on the N. edge of the S. equatorial belt, on which edge there is one light spot.

The N. equatorial belt is much disturbed, with curious light and dark markings and spots, the latter six in number. The S.S. temperate belt shown. Colouring good; definition must have been superb.

The extra sectional report referred to is from Mr. E. Holmes, and includes eight pencil drawings. In two, equatorial wisps are shown, and in several dark and light spots. On December 22, 1893, a row of five prominent light spots are shown on the N. tropical zone. The shoulder formation is always given strongly, and the disturbances in the N. equatorial belt are plainly shown. Many of the remarks are very interesting, and it is a pity the exigences of space assigned to this Memoir forbid quotation, for these outside contributions would be much valued by the sectional Members.

Below we give, *in extenso*, Mr. A. Stanley Williams' interesting observations of markings on the disk of Jupiter, during the opposition of 1893–4.

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## Observations of Jupiter in 1893–4.

By A. STANLEY WILLIAMS.

*The Red Spot.*—In the following table are given the observed times of transit of the middle of the spot, together with the longitudes, according to Mr. Marth's "Ephemeris for Physical "Observations of Jupiter, 1893–94" (System II.), and some notes upon the appearance of the spot:—

| Date. | G.M.T. of Transit. | Longitude. | Notes. |
|---|---|---|---|
| 1893. | h m | ° | |
| Aug 14 - | 13 15·5 | 356·0 | *ee F*, outline visible all round, except on the south. At times there was a distinct reddish tinge. |
| „ 16 - | 4 52·2 | 354·9 | *ee F*, at times the outline could be traced clearly on the N. and *f* sides, and less clearly on the *p.* end. |
| „ 23 - | 15 44·9 | 358·5 | Very rough observation; definition being very confused. |
| „ 28 - | 14 54 | 359·1 | *ee F*, very difficult owing to confused definition. |



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| Date. | G.M.T. of Transit. | Longitude. | Notes. |
|---|---|---|---|
| 1893. | h m | ° | |
| Sept. 4 - | 15 31 | 353·5 | *ee F*, a distinct though very faint reddish tinge. |
| „ 14 - | 13 52·2 | 356·8 | *ee F*, an obvious pink colour. The outline could be traced all round, except at the extreme *p* end, where it was ill-defined, and on the south where the belt interfered. The *s.f.* border was edged by a very narrow dark line. |
| Oct. 8 - | 13 35·8 | 355·3 | *e F*, quite distinct, except at *p* end; *s.f.* margin edged by a darker line, colour of spot pale pink. |
| „ 18 - | 11 50·4 | 355·4 | *ee F*, only a very slight pinkish tint, *p.* end very diffuse; *s.f.* margin edged with a dark line. |
| „ 30 - | 11 45 | 357·0 | *ee F*, colour pale orange, *s.f.* margin edged by a plain narrow dark line. At times even the *p.* end was seen, though not sharply defined. |
| Nov. 6 - | 12 31·5 | 357·9 | *e F*. Spot seen quite plainly, and outline traceable all round at times; *s.f.* margin edged by a plain dark streak. |
| Dec. 29 - | 11 15 | 360·4 | Spot *e F*, not difficult; *s.f.* and *f.* margins edged by a narrow dark border, a plain pinkish colour. Transit of the middle of spot not observed. The time given is the mean of the transits of the *p.* and *f.* ends. |
| 1894. | | | |
| Feb. 3 - | 11 3 | 359·9 | Very rough observation, definition being very bad; a reddish tinge obvious. |
| „ 18 - | 8 29·5 | 358·6 | *ee F*, a trace of pinkish colour apparent; *s.f.* margin edged by a darker line. The time is the mean of the transits of the *p.* and *f.* ends. |
| „ 20 - | 10 6·2 | 357·2 | *ee F*, spot exceedingly feeble, except on *f.* portion, where it was pretty plain and fairly deep pinkish in colour; *p.* end very indefinite |

The observations are somewhat less accordant than usual, doubtless because of the faintness of the spot. There was also a tendency to observe the transits later in bad definition. This was probably due to the greater faintness of the preceding portion of the spot, which in bad definition would tend to disappear, resulting in an apparent shift of the middle of the spot towards the east. It is obvious, however, from the longitudes in column 3 of the above table, that there has been little or no drift relative to the zero meridian of Mr. Marth's Ephemeris. The spot has remained nearly stationary since August 1892.



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*The Disturbed North Equatorial Belt.*—Generally speaking, Jupiter seems to have been rather in a quiescent state, but the greatly disturbed region about the north equatorial belt formed a notable exception to this. Some details, accompanied by drawings, have already been given by Mr. Waugh in the "Journal," Vol. IV., p. 88, and the subject will, doubtless, be fully treated in the present Report. Briefly, the nature of the disturbance, according to the writer's experience, is as follows:—In the early part of the apparition, small very dark spots made their appearance between the N. equatorial belt and the N. temperate band. These spots were usually joined to the N. equatorial belt by narrow, dark streaks. Simultaneously there was an outbreak of numerous small, very dark spots on the S. edge of the N. equatorial belt, and possessed of a rapid motion westward relative to the other markings previously alluded to. The appearance at this time strongly recalled that presented by the disturbance which broke out in the neighbourhood of the N. temperate band two years earlier, but on a larger and grander scale. In fact the two disturbances must be considered as of an analagous character. Later on there was a great extension of the dark material of the N. equatorial belt, which, filling up the bright spaces between the spots and streaks, then very numerous and complex, caused them in great measure to disappear from want of contrast.

One of the dark spots, nearly midway between the N. equatorial belt and the N. temperate band, was larger than the average, and unusually dark and definite, so that it formed for some months a very prominent feature of the planet. The following table contains my observations of this spot.

| Date. | G.M.T. of Transit. | Longitude. | Notes. |
|---|---|---|---|
| 1893. | h m | ° | |
| Aug. 19 - | 16 7·8 | 131·4 | *v S, v D, e* well defined, reddish? a very singular object. |
| „ 24 - | 15 16·2 | 131·5 | *S, v D*, well defined, deep reddish colour, quite isolated, very curious. |
| „ 26 - | 16 53 | 130·6 | *S, D*, very well defined, reddish. |
| Sept. 7 - | 16 36·7 | 124·1 | *S, e D, e* well defined; *v.* deep reddish; oval. |
| „ 12 - | 15 42·2 | 122·7 | *v S, e D, e* well defined, deep red. |
| „ 24 - | 15 34·4 | 121·9 | *v S, ee D, ee* well defined, blackish red. |
| Oct 19 - | 11 14·2 | 123·9 | *S, e D, e* well defined, deep red. |
| „ 30 - | 15 18 | 125·7 | *S, e D, e* well defined, *v.* deep red. |
| Nov. 7 - | 11 50·7 | 123·7 | *v S, e D, v.* well defined, *v.* red. |
| Dec. 1 - | 11 10·5 | 127·7 | *v S, v D*, well defined, deep red colour. |
| „ 11 - | 10 1·3 | 130·6 | *v S, w D, m* well defined. |



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The motion of the spot was not uniform, but at first there was a slight westerly drift, which gradually changed to a slight easterly drift. A number of other spots in the same latitude show a similar variable motion, so that the cause, whatever it may have been, of this rather curious variable drift, seems to have influenced a large region of the planet. In some longitudes there were local driftings of a different nature, but considering the evidently very disturbed state of this region of the planet in 1893, it is surprising that there should not have been greater changes apparent.

The spot above mentioned was of a very deep red colour, though, owing to its comparatively small size, this was not so noticeable as would otherwise have been the case. It was joined to the N. equatorial belt by a long, narrow, very dark streak, which was also noted several times as being of a red colour. Just preceding there was an intensely brilliant white spot, in strong contrast to the closely adjacent dark spot.

The above observations were all made with a 6½-inch reflector by Calver, usual powers 150 and 225. The following abbreviations are used in the tables of observations:—$S$ = small, $D$ = dark, $F$ = faint, $m$ = moderately, $v$ = very, $e$ exceedingly, $ee$ = very exceedingly.

Correction. In the fig. on p. 148 of Vol. II. of the "Memoirs," a very narrow bright streak connects a bright spot on the N. side of belt 5 with a bright spot on the S. side of belt 6 in long. about 60°. This is an error.

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## PART 3.

This part concerns satellite observation; with some exceptions the Director has to regret that the returns relating to such observations are not so copious as desired. All confess that satelline phenomena are among the most interesting and valuable of the planet Jupiter, and the hope is that the Members will, in time to come, respond to its interest by careful records of observations. Some few observations of the conjunctions of Callisto with the primary have been sent through the Rev. A. Freeman to Dr. Downing. It is to be desired that such and other reliable observations may be increased tenfold during the apparition of 1894–95. Though the interest attaching to possible duplicity, and to oblateness has been dispelled by Prof. Barnard's masterly thesis on satelline forms, the interest connected with changing albedo arising from bands, and other yet to be discovered markings, remains, and is fairly within the power of amateur equipment. Then the diverse colours, modified by relative position to each other and to the primary, are easy of observation, so that with transits, occultations, eclipses, and their beautiful phenomena, the satellites afford an unfailing field of deepest interest.

The returns of the Rev. S. J. Johnson, fully reliable as usual, are as follows, and are given intact:—

Eclipses of Satellite I., October—December, 1893.

1893.—October 7. $10^h\ 11^m\ 31^s$; manifestly fading. $10^h\ 12^m\ 56^s$; last glimpse.



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October 30. $11^h\ 22^m\ 17^s$; fading. $10^h\ 24^m\ 2^s$; last glimpse.

November 6. $12^h\ 17^m\ 44^s$; fading. $12^h\ 19^m\ 4^s$; last seen. Disappearance very close to the planet.

December 1. Reappearance. $9^h\ 9^m\ 40^s$; first seen, $9^h\ 11^m\ 5^s$, bright. Close to the planet.

December 10. $5^h\ 54^m\ 8^s$; first glimpse. $5^h\ 36^m\ 10^s$; bright. Power employed, 180 on $3\frac{1}{4}$-inch O.G.

Comparing time of last visibility with "Nautical Almanac" predictions in the first three cases, and time of first visibility with same in the last two cases, and taking the mean of all, a longitude within 13 seconds would be obtained. Those who are at all interested in this now disused method of getting an approximate longitude should peruse a paper in Vol. I., No. 3, of the "Monthly Notices" of the Royal Astronomical Society, April 1827, entitled "On Longitude of Madras from Eclipse of I. and II. Satellites of Jupiter," by T. Soldingham.

Mr. G. T. Davis returns as follows, in nearly every case showing the phenomena on a drawing. Those instances, where times are given are alone noted.

1893.—October 24. I. in transit. Internal contact, $8^h\ 38^m$. Last external contact, $10^h$.

October 31. I. in transit. Internal contact, $10^h\ 10^m$.

November 7. Callisto at W. tangent, $9^h\ 22^m$. External contact, $9^h\ 50^m$. Internal contact, $9^h\ 55^m$.

Remark. At 10.30 the satellite presented a greyish aspect.

Mr. Davis observed frequently the passage of the shadows, but times are not given.

Mr. Cammell's observations are as follows, G.M.T.:—

1893.—September 21. Satellite III. Occultation R., $11^h\ 18^m\ 50^s$.

September 22. Satellite I. Transit ingress. First contact, $10^h\ 22^m\ 30^s$. Fully on, $10^h\ 27^m$.

October 8. Satellite I. Shadow egress, $9^h\ 42^m\ 50^s$. Transit egress. First contact, $10^h\ 35^m$. Fully off, $10^h\ 39^m\ 45^s$.

October 22. Satellite I. Transit ingress. First contact, $11^h\ 58^m\ 30^s$. Fully on, $12^h\ 2^m\ 40^s$.

October 31. Satellite I. Shadow egress, $9^h\ 52^m\ 45^s$. Transit egress. First contact, $10^h\ 17^m\ 5^s$. Fully off, $10^h\ 22^m$.

November 7. Satellite I. Shadow ingress, $9^h\ 37^m\ 48^s$. Transit ingress. First contact, $9^h\ 51^m\ 43^s$. Fully off, $9^h\ 56^m\ 6^s$.

December 23. Satellite III. Occultation disappearance, $5^h\ 54^m\ 47^s$.

1894.—January 1. Satellite II. Transit egress, $7^h\ 7^m\ 47^s$. Fully off, $7^h\ 11^m\ 57^s$. Satellite I. Transit egress, $7^h\ 33^m\ 27^s$. Fully off, $7^h\ 37^m\ 42^s$.

January 28. Satellite III. Eclipse Reappearance. First appearance, $6^h\ 57^m\ 28^s$. Full appearance, $7^h\ 14^m$.

March 11. Satellite I. Transit ingress, $7^h\ 8^m\ 55^s$.



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Remarks. Observations were carried on during the whole apparition (eye estimates only) in order to determine the different brightness of I., II., III., IV. A large number of observations were taken, and on comparing them with each other the following results were arrived at. No. III. was invariably the brightest. No. IV. was the faintest. At western elongation IV. was generally brighter than I. or II., especially when I. or II. was approaching superior conjunction. At eastern elongation or thereabouts III. was always the faintest unless I. or II. were very close to the planet, in which case it perhaps equalled them in brilliancy, but never exceeded them.

Satellites I. and II. were about equal in brightness, but sometimes I. was brighter than II., and *vice versâ*, according to their position at superior or inferior conjunction, or nearness or distance from the planet. From the foregoing it appears that IV. is distinctly brighter when at western elongation than at eastern. These observations seem to be verified by the general ability of observers.

Mr. Maw's return is as follows :—

1893.—December 9. Satellite I. and its shadows in transit, but satellite not seen until $7^h\ 40^m$. Egress of ditto, bisection of satellite noted as taking place at $7^h\ 49^m\ 50^s$. That of shadow at $8^h\ 22^m\ 33^s$.

December 23. Satellite I. Transit ingress approximately $9^h\ 9^m$. The satellite passed along with its southern edge just level with the southern edge of the S. equatorial belt.

December 23. Satellite I. Shadow ingress $10^h\ 1^m$. The shadow well away from limb $10^h\ 14^m$. Very sharp and black, *see* sketch, Fig, 16, Plate II.

Mr. MacEwen reports as follows :—

1893.—October 4. The shadow of Satellite II. traversing the entire length of the S. equatorial belt. The shadow was almost black, with a curious halo of light extending to nearly its diameter. The boundary of this halo fading gradually away. II. was in contact at $12^h\ 10^m$. Predicted time, $12^h\ 9^m$, confirmation desired.

Rev. T. H. Foulkes records that he watched the eclipse disappearance of Satellite I. on October 30, 1893, and he thought the record to a particular second impossible. He remarks : " It is " a gradual affair, lasting several seconds, getting fainter and " fainter, and giving the impression of being afraid of entering the " black shadow." He says, " there must be a good amount of " penumbra to the shadow of the planet. There was a perceptible " change of colour, getting fainter and fainter." Satellite invisible $10^h\ 24^m\ 30^s$ G.M.T. A most interesting and instructive sight.

Mr. Goodacre's returns are as follows :—

1893.—October 31. $9^h\ 30^m$. Satellite I. in transit, but not seen. Its shadow well seen to one-fourth distance of W. limb.

November 5. $10^h\ 40^m$. Satellite II. in transit, quite within the limb at the above time, preceded by its shadow, which had advanced one-third the diameter



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of the planet. The shadow was one diameter of the satellite further north, *i.e.*, different in latitude.

November 12. Satellite III. Occultation. 1st contact $5^h$ $35^m$. Not lost sight of until $5^h$ $55^m$. Reappearance, $7^h$ $30^m$.

December 30. Satellite III. Occultation. 1st contact, $9^h$ $5^m$. Not lost sight of till $9^h$ $25^m$. (Unusually long).

Mr. A. Freeman returns:—

1893.—December 16. Eclipse. Satellite III. Emerging, $6^h$ $46^m$ $37^s$. Middle of reappearance, $6^h$ $50^m$ $51^s$. "Nautical Almanac" time, $6^h$ $49^m$ $40^s$.

December 16. Eclipse. Satellite II. Emerging, $9^h$ $16^m$ $17^s$. Middle of reappearance, $9^h$ $19^m$ $36^s$. "Nautical Almanac" time, $9^h$ $18^m$ $21^s$.

The following notes are selected from the Director's note-book, as of interest, though possibly useless:—

1893.—August 14. Satellite I. Transit. 1st contact $12^h$ $12^m$. Last ditto, $14^h$ $20^m$. Shadow well seen traversing S. tropical zone.

August 23. Satellite III. Eclipse. Beginning $13^h$ $1^m$. Emergence not seen. Took full $7^m$ from first effect of planet's shadow to total extinction.

September 11. Satellite II. Occultation. Ingress, $10^h$ $47^m$. Full egress, $13^h$.

October 31. Satellite I. Transit. Fully on, $8^h$ $10^m$. Quite off, $10^h$ $20^m$.

November 7. Satellite I. Transit. Fully on, $9^h$ $54^m$.

November 23. Satellite I. Transit. Fully on, $7^h$ $46^m$. Just off, $9^h$ $59^m$.

December 9. Satellite I. Transit. Fully on, $5^h$ $40^m$. Just off, $7^h$ $49^m$.

December 16. Satellite I. Transit. Fully on, $7^h$ $23^m$. Just off, $9^h$ $36^m$.

1894.—March 6. Satellite II. Transit. Fully on, $4^h$ $12^m$.

1893.—October 6. Satellite II. was quite as bright as Satellite I.

September 6. Satellite I., when just on disk, seemed very decidedly oval. Major axis N. and S.

It is hoped that several of the Members will be able to apply the principles of observing the satelline eclipses so admirably laid down by Dr. Downing in a paper on the subject in the November 1890, number of the "Journal," and if not, it is hoped that all observers will be able to indicate the moment of fading, and invisibility and the converse, thus affording four data from which to obtain a mean indicating probably the time of the middle of the eclipse; but the photometric method advised by Dr. Downing has advantages over any other yet propounded. A careful study of the paper referred to will, in any case, be an education on the subject.



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## PART 4.

This Part, as heretofore, will consist of a brief summary of work done by the Section, and some deductions therefrom.

1. The positions in latitude of the belts and markings, as delineated on the drawings sent in, though leaving in some instances much to be desired, are far more correct than in previous Memoirs; moreover a conscientious desire for accuracy is being cultivated, which is sure to induce carefulness, resulting in increasing correctness. The sectional *esprit de corps* is no unimportant factor in this and other similar matters. The time of the passage of the central meridian, though generally an estimate, is aidful in securing accuracy.

2. The colouring of the belts and makings is more closely attended to in this Memoir, and, making allowance for idiosyncrasy, is more true to the original, often so difficult to catch. Allied to this there is the native delicacy of tone, so difficult (some say impossible) of delineation. The Director could instance nearly a hundred drawings, not far behind the best specimens extant, proving that if absolute representations are impossible, a measure of success is attainable, even if but few members are born artists. In reference to this matter, the remark of Capt. Noble should not be forgotten, namely: "That delineations, like "handwriting, are individual traits." While the best draughtsmen in the Section will create an ideal standard, identity of style is a natural impossibility, and perhaps not desirable, diversity often tending to mutual correction.

3. The Director cordially invites criticisms and comparisons, but suggests that the whole of the environment of each draughtsman should be taken into account, and such embraces locality, Birmingham being diverse to Dorchester, or Bermondsey to Wokingham. Then there is the actual state of the atmosphere at the time of the observation, steady or tremulous; thick or translucent; and the not fully understood aërial conditions which baffle to an extent trying to temper, and often leading to an abrupt termination of work. Diversities of aperture, powers, &c., and inaptness (which some observers never quite overcome) in making the necessary adjustments. The relative advantages or disadvantages of reflectors and refractors for planetary work, and last, but most important of all, the penetrating power of the eyesight, so variable, according to health, age, and occupation during the day, and opportunities for training it. Then, in addition, there is that placidity of temperament which in part is an endowment, but certainly a result of method in observing. One more element for correct judgment demands notice, viz., that there is no department of observational astronomy more difficult and beset with obstacles than planetary markings and phenomena, so that criticism should always be accompanied with experience. Anyone who has rarely tried his own hand in delineating what he sees is seldom a competent judge of the drawings of others, and this is especially true in astronomical sketches.



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4. We now proceed to a generalized description of the leading planetary features with deductions, and the first point claiming attention is the now almost defunct *Great Red Spot*, than which no more remarkable feature has presented itself during the century. It is not quite gone from view when seeing conditions are first class and aperture is adequate. It is shown in no less than 22 drawings relating to the opposition of 1893–94, in a few cases quite plainly, the entire margin being seen. In one instance M. Antoniadi represents it with the aureola (No. 244); Mr. Cammell shows it ringed (No. 19), but in most cases it is little more than a slight stain; the following portion being generally the more distinct. It is still spoken of as being pinkish in hue. Its appearance is far too diffuse to be of much value in determining its rate of proper motion, always very small, or assisting in ascertaining the rotation period of the planet. Is its apparition cyclical? possibly it is, though with varying intensity. To discover this feature, if a fact, is a very suitable enterprise for the Section.

5. The faint equatorial belt is better shown by the drawings dealt with in this Memoir than by those of any previous one. No less than 51 sketches show it. Messrs. Cammell, Antoniadi, Maw, and MacEwen are the most successful in seeing it, sometimes it is much broken up, sometimes almost continuous from limb to limb, sometimes it is best seen at the following portion of the disk, at others on the preceding; occasionally it is shown diffuse, at other times as a very slender line. These varieties of aspect are, no doubt, partly optical, but mainly, it is thought, real. Many observers favour the idea of variability. Though a large aperture is desirable to show it, it being largely a light test, the Rev. L. A. Williams saw it with a 4-in. O.G. (No. 169). It is a good atmospheric test, and if well held in view, seeing conditions must be good. Its broken aspect is probably owing to overlying light vapours, too delicate for detection in themselves. Its general appearance is that of a thin and very delicate line, pulsating under atmospheric and optical influences, and perhaps the most fascinating of the planet's features. Lord Rosse's or Mr. Knobel's drawings in the "Monthly Notices of the Royal Astronomical Society" do not show it, a result arising probably from the overlying masses of darker vapour prevailing at those dates. Prof. Keeler shows it diffusely and broken by overlying vapours in his well-known and superb drawings published in the "Proceedings of the Astronomical Society of the Pacific;" also in three beautiful drawings in Indian ink, with which he has favoured the Director, these being made with the 13-in. O.G. at Allegheny. We quote these to intensify the interest of the Section and the British Astronomical Association generally in this feature. As illustrative of these remarks, *see* Drawings Nos. 1, 113, 175, 178, 188, 94, &c.

The light spots and massed markings in the equatorial zone have been very numerous during the apparition; about 15 per cent. of the drawings show them. Messrs. Davis, Cammell, MacEwen, Mee and Antoniadi, represent them in drawings Nos. 32, 99, 53, 189. The spots when well defined are sometimes adherent to the edges of the equatorial belts. They are more diffuse and



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larger when lying nearer the equator. They are frequently so broken up into smaller fragments as to give in more limited apertures a marbled and mottled appearance to the zone. Drawing No. 154 is a specimen. That these spots and markings are vapours in the upper region of the planet's atmosphere there can be but little doubt. Mr. Green strongly advocates this theory. Their tint somewhat varies, being occasionally of a lustrous brightness, and sometimes slightly tinted. Mr. Offord shows them of a bluish tone, *vide* drawings Nos. 3, 37, 173. (*See* Interim Report on the Equatorial Zone.)

A very interesting feature of this zone is the strange, almost weird wisps before referred to. They are sometimes very difficult to catch, and are thought, with great probability, to be a capital test of keen vision. They generally proceed from dark spots on the N. edge of the S. equatorial belt, and frequently reach similar spots on the S. edge of the N. equatorial. Their trend is almost always from west to east (*see* some remarks on this in the paper on the winds of Jupiter in the "Journal," Vol. IV., page 359). There are no markings more variable, curious, and unaccountable than these wisps. It appears as if the spots on the N. edge of the S. belt were attracted by those on the S. edge of the N., as sometimes the extension is only partial across the zone, as in a sketch by Mr. Cope, No. 48. It is hoped the section may yet compel the revelation of the secret of these wonderful wisps. For illustrations, *see* drawings by Messrs. Maw, Antoniadi, Cammell, Goodacre, MacEwen, Cope, &c., as specimens Nos. 226, 30, 113, 165, 167, 183. Mr. Wykes also shows this feature in No 125, as seen with 4½ O.G.

6. The S. equatorial belt, though yielding in interest to the N. during this apparition, has generally been the most prominent and attractive. Its aspect and varying phenomena have received full attention in 1893 and 1894. It almost goes without saying that the whole of the 252 drawings show it plainly. It is probably the most permanent—though variable in itself—of all the belts. About 35 per cent. of the drawings show this belt double. Some very plainly, as Messrs. MacEwen, Corder, Cammell, and Antoniadi, others more diffusely. Mr. Ellis and Mr. Goodacre shows the division as an oblique line (No. 46). This tendency is found in some other drawings giving a forked appearance to that part of the belt. There are times when all the seeing conditions are good when the division is not easily perceived, as if the overlying white drifted matter had lost its luminousness, or had been absorbed in the darker matter of the underlying belt.

Longitude permitting every drawing shows the heaped up portion called the shoulder. The wherefore of this strange and unique formation is one of the Jovian problems. If a repellant power of the Great Red Spot immediately preceding, electricity may be the cause (*see* the article on the Jovian winds before referred to). The edge nearest the red spot is almost always the densest, its density making it one of the darkest features on the planet, sometimes the curve is sharp, at others gentle; sometimes the latitude of its point is more southerly than at others. It certainly is not less prominent now than when, in 1880, the Great Red Spot was densest, a fact, which almost suggests that that



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feature has little to do with its formation. When the red spot has gone, will the "shoulder" go also? It is thought not. This will be an object of interest to discover (*see* drawings by Mr. Maw, No. 25; Mr. Davis, No. 32; Mr. Offord, No. 37; Mr. Mee, No. 239; Mr. Corder, No. 246, &c.)

Dr. Smart shows a curious looped appearance N. of this belt in drawing No. 86. This is unusual this apparition, though during previous ones it occurred occasionally. Dr. Smart shows the same feature in an incipient stage in drawing No. 8; also Mr. Wykes in 201. Mr. G. L. Brown, in drawing No. 200, shows some curious dark spots on the body of this belt. Other observers verify these.

7. The N. equatorial belt. As the abnormal activity of this belt has been the subject of an interim report, with numerous illustrations, published in the "Journal," Vol. IV., page 88, it is unnecessary to enlarge upon it here, except to say that the activity continued during nearly the whole apparition, showing, however, some slight signs of ceasing at the close. Nearly every drawing to hand shows it, and as it formed a specialité with many observers there is no doubt the delineations, though sometimes strongly given, are generally very correct. The activity extended to every portion of the belt, pervading the entire circle of the disk. Some of the markings were very curious, and sometimes very dark, though generally pervaded with the reddish tone of the body of the belt. Portions seemed as if torn asunder by violent cyclonic action. The apparent openings in the belt were probably caused by overlying light vapour which assumed very strange shapes occasionally. The extensions N. and S. seemed to be projected by great forces in the body of the belt. The dynamics of Jupiter were probably never more fully illustrated than in this apparition. In addition to those published, *see* drawings Nos. 167, 168, 174, 76, 86, 22, 29, 52, 80, 90, &c.

8. The Tropical Zones, N. and S. The S. zone has not been marked with much activity, this apparition, though it has exhibited its usual brightness, competing in this feature with the N. tropical zone, and frequently exceeding it. It is sometimes shown mottled, notably by Mr. Mee, also occasionally dark lines, hardly belts, have been seen on it, *see* Nos. 55, 242, 62. This zone is frequently scanned, as transits often occur on it. The N. tropical zone has not been so bright or wide as usual, owing, perhaps, wholly to extensions from the N. equatorial belt; indeed, sometimes it has been so narrowed and obscured as to seem at first sight absorbed into the active belt just mentioned. It has, however, preserved its integrity as one of the permanent zones on the disk. The dark spots that have appeared on it have evidently been apparently detached from the N. equatorial belt again to be absorbed into it. Mr. MacEwen shows this feature in Nos. 53, 93, and other drawings. Also Messrs. Antoniadi in Nos. 26 and 99, Corder in No. 82, Foulkes in No. 182, Cammell in No. 92, Evershed in No. 97, Ellis in No. 36, and Davis in No. 16, where the zone is almost obliterated. Indeed, nearly every observer shows it more or less as compressed.



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9. The S. temperate band, so active during the last two apparitions, has been comparatively quiescent this. It is a question whether there has been any trace of the dark streak, though some observers show something like it, for instance, Mr. Buttemer in No. 133, and Dr. Smart in No. 86. By some this band is shown very faint (*see* No. 211), but it is generally shown from limb to limb. Some few show it much distorted, the line being bent; for instance, Messrs. Cope and Antoniadi in Nos. 99 and 90. It is generally shown very thin, as by Dr. Ryle in No. 236; also nearly the whole of Mr. Cammell's drawings show it thus. In a few instances it is much more marked, as by Mr. Wyke's in No. 232, and Mr. Offord in No. 224. Making all allowance for diversities of aperture and seeing, it is fair to conclude that there are all the elements of a renewed activity, so that the band should be carefully watched that none of its features escape observation. For the past history of this band proves that at any time there may be renewal of activity, and possibly another appearance of what was called "the new red spot."

10 The N. temperate band. This, as usual, has been very dense and dark, on the whole, not so wide as during late apparitions. Every drawing shows it, indeed, with the two equatorial belts, it is and has been a prominent feature of the disk, and perhaps the darkest of the bands. No drawing shows any activity or irregularity of outline. It has been, so far as the drawings show, in a state of perfect rest, except, perhaps, a few dark spots hardly discernible, for instance, in drawing No. 154, by Mr. Mee. When seeing conditions are first class, duplicity is occasionally detected. Instances are found in Mr. MacEwen's drawings, for instance, Nos. 53 and 93, also, very faintly, in the drawing No. 183 by Mr. Antoniadi in No. 183.

11. S. temperate zone. Light spots are frequently seen in this zone, sometimes they are in regular line and equidistant, sometimes they seem to overlap the adjacent bands slightly, presenting clearly the appearance of super-position, as is probably the fact; should they present a more rapid movement than the planet's rotation, they would demonstrate their elevation. There has been no record, but they should be watched with reference to this point. Messrs. Cammell, Mee, and Antoniadi show them frequently (*see* drawings Nos. 175, 207, 154, 155, 165). They are evidently very difficult objects, and some observers are gifted in detecting them. They are certainly among the most interesting on the disk, and possibly have revelations to make which will amply repay close attention.

12. The N. temperate zone also, is a hunting ground, though less prolific, for white spots, occasionally accompanied by dark ones. There have been but few recorded by the Section. Mr. Cammell has again been among the most successful in detecting them (*see* drawing No 211), also Mr. Mee (*see* No. 242). This zone is almost invariably shown very bright—during the present apparition as bright as the N. tropical. This brightness has probably been occasioned by the prevalence of a number of scarcely discernible spots, apparently running into each other,



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or even overlapping. The remarks made under the 11th section will apply here. It is certainly an area for fresh discoveries, and the larger apertures will probably be successful in making them.

13. The S.S. temperate bands and zone, and the N.N. temperate bands and zone, are more frequently shown this apparition than heretofore. They rarely possess any very marked features, and seem very evanescent. It is an acknowledged difficulty to hold them, though occasionally they are much more prominent, suggesting variability. The probable cause of the irregularity is that they are necessarily seen on the declining curve of the ball, hence observed obliquely, the light undulations from them passing through a larger portion of the planet's atmosphere like our setting sun, and being therefore absorbed and refracted with the usual agitations. (*See* drawings Nos. 86, 89, 15, 145, 149, 153, 154, 168, 169, and 188. In the latter sketch Mr. Mee shows a singular connection by a dark marking between the two southern bands, with light spots on either side.)

14. The polar regions. The N. one is generally shown darker than the south, also of the usual bluish tone, intensified where the colour perception is keen. Mr. Offord's drawings show this plainly (*see* No. 224 and Mr. Cammell's No. 219). Sometimes this region is shown ringed, as if there were a succession of slender bands. This appearance is not infrequent, and is very beautiful when well seen. It is rarely seen in the S. polar regions, but a few drawings show it, notably one by Mr. Goodacre, No. 226, and one by Mr. Offord, No. 173.

It is hoped that the revived study of terrestrial cloud formations will afford clues, by analogy at least, to the causes of the strange forms which everywhere pervade the atmosphere of Jupiter.

Permit the Director to say, in closing this Memoir, that he has an increasing conviction that a studious observation of this giant planet has a strong tendency to elevate and refine the mental powers, as well as largely augment the felicities of life.

Portland,
August 15, 1894.

W. R. WAUGH.



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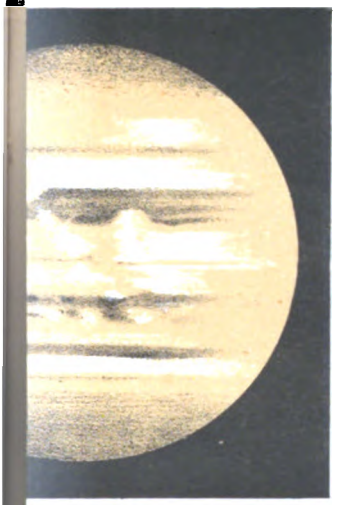


ell 12½in Spec. Power 200.
12. 8h 15m Longitude 25° 4'.

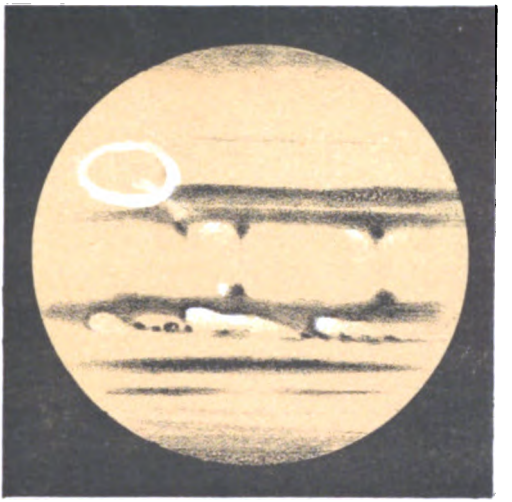


Fig 5. E. Antoniadi 9¾in O.G.
1893. Oct. 20. 14h 20m Longitude 27.°

e 8½in Spec. Power 250.
7. 8h 30m Longitude 66°.

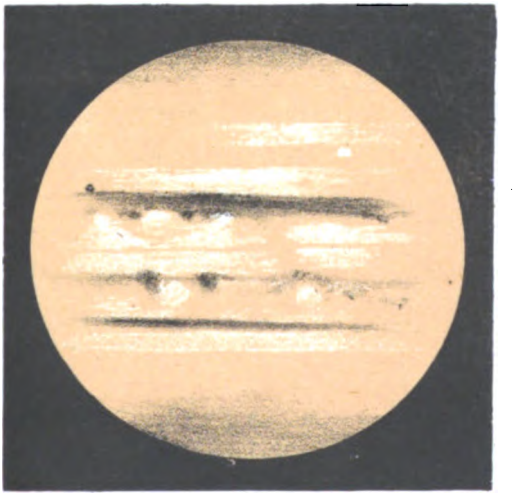
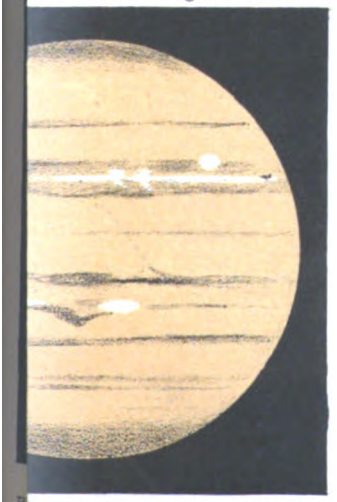


Fig. 10. B E Cammell. 12½in Spec Powers 150 & 200.
1893. Oct. 31. 9h 35m Longitude 68°. 9.



in O.G. Powers 120, 160 & 180.
3. 9h 35m Longitude 118°.

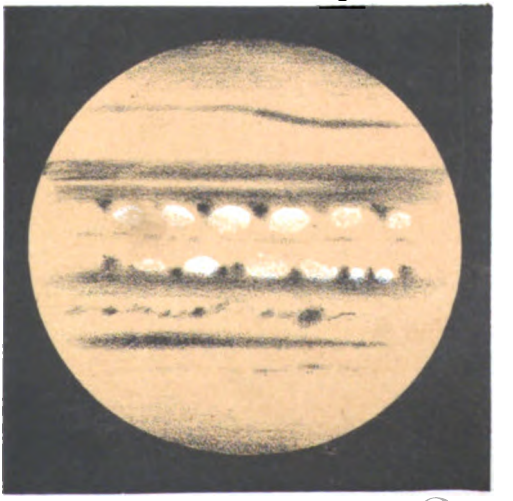


Fig. 15. E. Antoniadi 9¾in O.G.
1893. Oct. 19. 10h 50m Longitude 121°.

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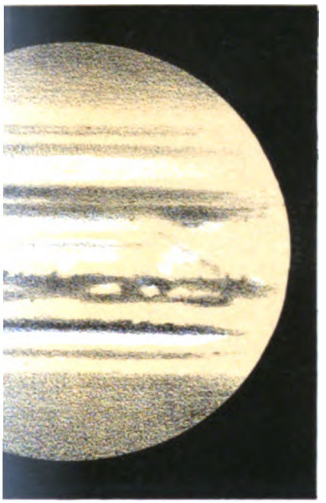


ıell. 12½in Spec. Powers 200 & 300.
29. 6h 40m Longitude 194°.8'.

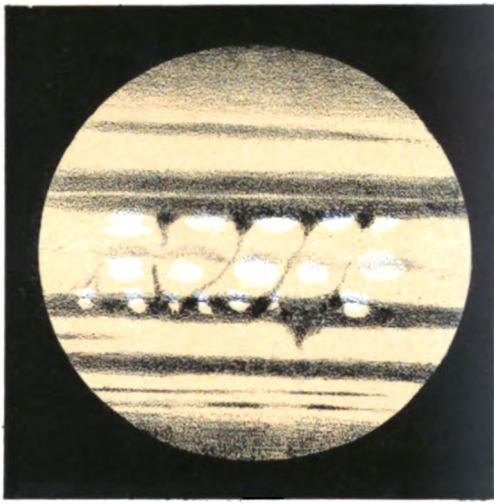
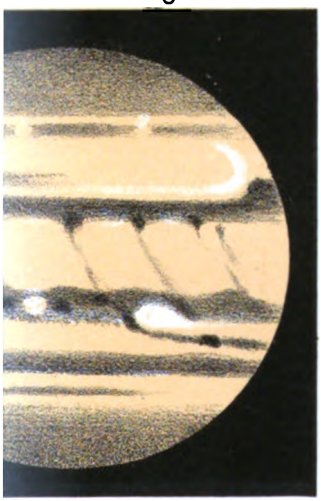


Fig. 20. E. Antoniadi. 9½in O. G.
1893. Oct. 20. 9h 20m Longitude 205°.



adi. 9½in O. G.
20. 12h 20m Longitude 255°.

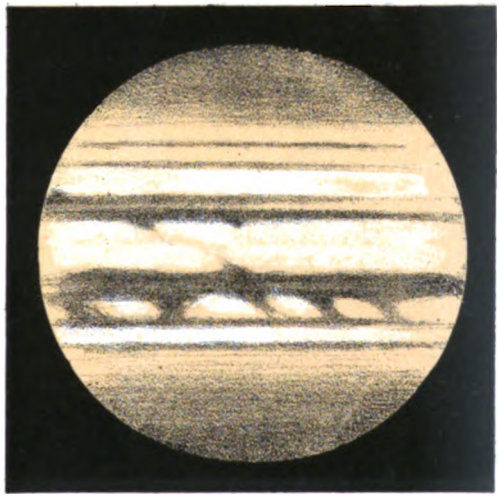
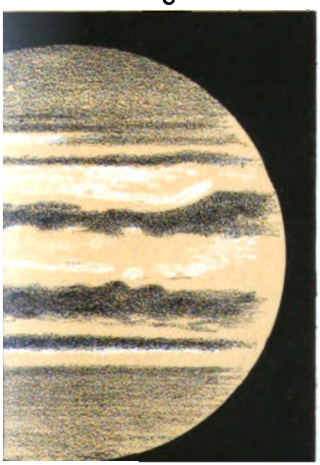
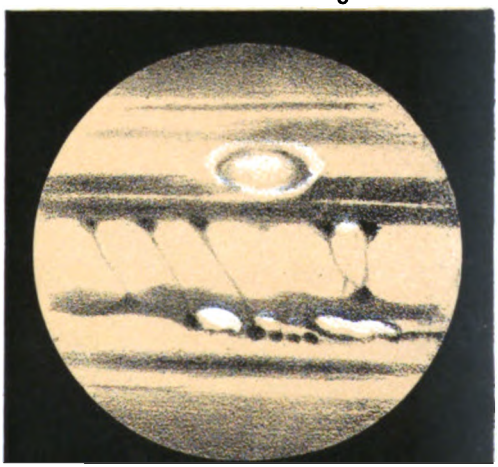


Fig. 25. B. E. Cammell. 12½in Spec. Power 200.
1894. Feb. 18. 5h 50m Longitude 262°.6'.





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# SECTION FOR THE OBSERVATION

OF

# THE MOON.

DIRECTOR.—T. GWYN ELGER, F.R.A.S.

## *THIRD REPORT OF THE SECTION.*

### Introduction.

It is clear from the present Report that there is no diminution in the interest taken by the Members of the Section in the study of the physical features of our satellite, which, in fact, continues to grow not only within the Association itself, but wherever societies exist for the encouragement of observational astronomy. No further proof of this is needed than may be furnished by comparing the condition of selenography only a very few years ago, when the number of observers who took any but a desultory and spasmodic interest in the subject was exceedingly small, with its position at the present time, when some of the largest telescopes in the world and the most skilled observers are, to a great extent, devoted either to the direct observation of the details of the moon, or to the production of photographs of her surface.

The progress that has been made in lunar photography, especially as regards direct enlargements of selected regions, marks a new departure in selenography, and will, doubtless, result before long in the production of very excellent photographic representations on a large scale of a great portion, if not of the whole, of the visible disk; thus furnishing a solid foundation for a more critical examination by direct observation than has hitherto been attempted of detail far too delicate to be recorded on the sensitive plate, but which, in fact, includes the most interesting and suggestive features on the moon. Though, in the words of Prof. W. H. Pickering, "the photograph does not at present even hint at the existence" of such details, it supplies a picture of salient objects and grosser features which are invaluable as points of reference and for alignments.

Among the more remarkable observations recorded in this Report are those received from Herr Brenner, of the Manora Observatory, Lussinpiccolo, made with a 7-inch refractor by Reinfelder and Hertel, Munich, which appears to be an instrument of extraordinary excellence. As will be seen by the list, these records relate to a large number of formations in every part of the moon, but it has been only possible in a few instances to reproduce



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the observer's notes in anything approaching completeness. Those referring to Hyginus N are certainly the most astonishing, for, in anything but ideal observing weather, very many details in the neighbourhood of this celebrated depression were seen with comparative ease, which no one has hitherto detected, and which, so far as I am aware, no one has succeeded in seeing since. No time should be lost in the endeavour to confirm or otherwise these observations, for if these features exist, they point to changes of great local magnitude that have occurred since the neighbourhood was so diligently scrutinised by some of the most competent observers 18 years ago.

It will be noted that fair progress is being made with the chart of Ptolemæus, though more volunteers with comparatively large telescopes, and who are able and willing to undertake measures of the positions of objects on the floor, are needed and it is hoped will ere long be forthcoming. Mr. Maw's measures, published in the last Report, have been of considerable service, but many additional ones are required.*

The recent publication in "The Annals of the Astronomical Observatory of Harvard College," Vol. XXXII., Part 1, of Prof. W. H. Pickering's remarkable observations of the so-called lunar river-beds and variable spots made with the Boyden equatorial of 13-in. aperture at Arequipa, Peru, are of extreme interest and importance to all students of the moon's surface, and may be said to mark an epoch in selenography. Though it is, unfortunately, impossible in less ideal observing stations to follow these observations, however perfect our optical means may be, so as to see the curious details revealed at Arequipa, within the dark spots in Atlas, Alphonsus, and elsewhere, or the minute river-beds so plentifully distributed in various parts of the moon, the attention of observers may be usefully directed to the variation in the depth of shade under different lunar phases of some of the dark areas Prof. Pickering specifies. To any Members willing to persue investigations of this nature, the Director will be pleased to furnish information as to the positions, the general character of the spots, and other details respecting them.

### Members of the Section.

BACON, Miss G., Coldash, Newbury. $4\frac{1}{10}$ O.G.

BAIKIE, Rev. James, F.R.A.S., Ancrum, Roxburghshire, N.B. $3\frac{7}{8}$-in. O.G.

BRENNER, Leo, Manora Sternewarte, Lussinpiccolo, Istrien. 7-in. O.G.

BROWN, G. L., 22, Nelson Place, Stirling, N.B. $3\frac{1}{4}$-in. O.G., $10\frac{1}{2}$-in. Spec.

BRYANT, G., 118, Thomas Street, Kennington Park, S.E.

CARR, Rev. Canon E., F.R.M.S., Holbrooke Hall, Derby. $4\frac{1}{4}$-in. O.G.

CORDER, H., Sunnyside, Bridgwater. $6\frac{1}{2}$-in. Spec.

DAVIS, G. T., 13, Donnington Gardens, Reading. $3\frac{3}{4}$-in. O.G.

* Since this was written, Mr. S. A. Saunder, M.A., Wellington College, has kindly undertaken to assist in the micrometrical work required. His telescope is a 7-in. equatoreal refractor by Troughton and Simms.



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ELGER, T. Gwyn, F.R.A.S., Bedford, *Director*. 8½-in. Spec., 4-in. O.G.
ELLIS, Henry, Inglefield, Little Heath, Potters Bar. 6-in. O.G.
FORBES, G. Stuart, C.S., Tinevelly, Madras Presidency.
FREEMAN, A., 67, Freshfield Road, Brighton. 10½-in. Spec.
GOODACRE, W., F.R.A.S., Highgate. 12-in. Spec.
GORDON, T., F.R.A.S., Whitehaven. 6-in. Spec.
HALLOWES, G. P. B., F.R.A.S., York.
HEBERT, Rev. S., Ivor Vicarage, Uxbridge.
HUGHES, J. Gwynne, Maldon, Essex.
HUTCHINGS, Rev. R. S., F.R.A.S., Alderbury, Salisbury. 12½-in. Spec.
JACKSON, John, Beswick House, Blackpool.
JONES, J. H., F.R.A.S., Montpelier, Bristol. 8½-in. Spec.
KEMPTHORNE, Rev. P. H., F.R.A.S., Wellington College.
KING, H. A., The Library, 51, Church Street, Upper Norwood.
LAMBERT, Lieut., D.R., R.E., Fort Frederick, Trincomalee, Ceylon.
MAW, W. H., F.R.A.S., 18, Addison Road, Kensington. 6-in. O.G.
MEE, A., F.R.A.S., Cardiff, South Wales. 8½-in. Spec.
MENTZENDORF, Stanley, Nutley, Surrey. 2½-in. O.G.
MOLESWORTH, Lieut. P. B., R.E., Bexley, Kent. 9¾-in. Spec.
PATERSON, A. Gordon, M.A., M.D., South Lodge, Ascot. 10-in. Spec.
PHIPPS, E., Postal Telegraphs, Maidstone.
POPE, James T., Alma Cottage, Dingwall, N.B. 3-in. O.G.
RADMORE, T., 149, Queen's Road, Portsmouth. 3½-in. O.G.
SHELDON, Dr. T. S., F.R.A.S., Macclesfield. 4⅝-in. O.G.
SMART, D., M.R.C.S., F.R.A.S., 108, Grange Road, S.E. 10-in. Spec.
STEPHENSON, J. T., 67, High Street, New Brompton, Kent.
STEWART, Rev. W. E., F.R.A.S., Harworth-on-Tees, Darlington.
THORPE, Rev. W. Paxton, Reigate, Surrey.
TUCKFIELD, Rev. J. H., Melville Street, Hobart, Tasmania. 10½-in. Spec.
YOUNG, G., 24, Friar St., Perth, N.B.

## Ptolemaus.

Whether we regard its dimensions, its structural peculiarities, or the remarkable features it includes, this walled plain is undoubtedly one of the most interesting and suggestive formations on the visible surface of the moon. For this reason, and because existing representations of it are manifestly defective, it was selected by the Director as an object especially suitable for scrutiny by the Members of the Lunar Section. with the view of preparing a chart, on a large scale, which should exhibit, with all possible accuracy, every feature on the rampart and in the interior which can be detected with instruments of moderate size.

Though good progress has been made in this work, very much remains to be done before it can be said to be approaching completion. Mr. Maw's micrometrical measures of the position of salient points on the border and elsewhere (published in the last Report) have been of great service, but many more are required



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before it will be possible to fix those of many other important features with exactness. This is an undertaking which demands much time and patience, as it often happens that many lunations pass before an opportunity offers, combining good atmospheric conditions and a suitable phase for micrometrical work. Much, however, may be done by utilising for alignments many of the points which have already been fixed. Observers, as a rule, neglect this method, and hence the great difficulty in identifying many of the objects represented in their drawings and diagrams. With a view of assisting them in this matter of alignments, and to show the progress that has been made in the preparation of the monograph, the Director has prepared the accompanying map (Plate I.) which, of course, must only be regarded as of a provisional nature. The general shape of the border is derived from photographs (Lick Observatory, Rutherfurds, &c., &c.), while its details (passes, cross valleys, &c.), are reproduced from sketches made at various times. It may be remarked, by the way, that the character of this rampart—its polygonal (hexagonal) shape, and the structure of its component parts, is utterly subversive of the notion that it was formed by the ejection of matter from a central vent, even if such a formation existed on the floor. It awaits a more feasible hypothesis.

The scale of the map may be roughly stated to be about 46 miles to an inch, the diameter of Ptolemaus being taken as 115 miles. The great crater (or rather crater cone) A is apparently between 4 and 5 miles in diameter, and rises somewhat abruptly from the floor to a considerable altitude for an object of this class, as is evidenced by its shadow, which bears much resemblance to that of Bessel in the Mare Serenitatis, and, like this object, appears to have at least one prominent isolated peak on its rim, which is seen to stand out at a certain phase of sunrise as a bright point amid the shadow cast by the lofty peak $\eta$ on the western rampart. It will be seen that 14 of the curious large shallow cup-shaped depressions, so peculiarly characteristic of the formation, are shown in the map. Every observer who has bestowed attention to the floor under a low angle of illumination knows that there are many more—at least double this number. Drawings by Mr. Davis and Mr. Mee show many that do not appear here, because it has been impossible, in the absence of alignments, to fix their position from the sketches. Those set down, with one or two exceptions, undoubtedly stand where they are represented. They are peculiarly difficult objects to identify from time to time. Not only, from their shallowness, is their visibility very ephemeral, but they appear to be of very irregular form within, so that slight variations in the azimuth of the sun occasions apparent changes in their appearance as remarkable as those produced by variations in its altitude. Most of them have low rims, and some include minute craters that may be seen with tolerable ease, long after every trace of the shallow hollows in which they stand has disappeared. One can hardly avoid regarding them as buried rings—the relics of formations overspread and all but hidden from view by the material which now represents the floor, and which, to all appearances is the same as that of the so-called "seas." They are coloured a darker tone in the map, not because



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there is any difference between their hue and that of the rest of the interior, but simply for greater distinctness.

The accompanying catalogue will be found useful to Members of the Section.

### SHALLOW CUP-SHAPED DEPRESSIONS.

*a*. Large oval depression, extending from the N. side of the crater A towards the N. wall. It is an easy object and is clearly traceable on good photographs, taken at a suitable phase. Its rim is very low, but is seen without difficulty under a very low angle of illumination. Shown by Mädler and Schmidt.

*b*. A similar depression, associated with the northern flank of *a* and abutting on the northern border, which has apparently interfered with its continuity. It is more difficult to see than *a*, as it is generally involved in the shadow of spurs and other details of the wall. It has craters on its rim.

*c*. Another object of a like kind, flanking *a* and *b* on the W. First noted by Mr. Maw. It is more difficult to trace than the other two. Both *b* and *c* were revealed during the examination of the floor by the Members of the Lunar Section.

*e*. A smaller depression on the southern side of the floor, seen by Mr. G. L. Brown, Mr. G. T. Davis, and myself, but not shown either by Mädler or Schmidt. Position approximate only.

*f*. A depression of about the same size, seen by Mr. Goodacre, 1893, March 25, and by myself on several occasions. Doubtfully recorded by Mr. Mee. It is close to the south-east wall, and roughly aligns with crater A and *i*. Mädler shows a depression nearly on the site.

*h*. A large depression near the E. wall with a crater on its northern rim. It is always prominent at sunrise. It aligns with a point on the north-west border, about midway between the craters G and 21, and the crater A. It was well seen by Dr. Sheldon, 1893, January 25, $6^h\ 40^m$, but has frequently been previously recorded. It is shown by Schmidt, as is also the crater on the rim, and one within.

*g*. A depression of about the same size adjoining *h* on the south-west. It was well seen by Dr. Sheldon on the above-mentioned date, and also by myself, 1890, May 26, $10^h$, when it appeared to partially overlap its companion. It was evidently seen by Mr. Mee, 1894, May 12, $8^h\ 30^m$. Not drawn by Schmidt. Dr. Sheldon noted a light spot S. of *g* (shown by a dotted line in map).

*i*. This depression clearly occupies the site of the crater *c* in Mädler's map, and appears to correspond with the large rimmed depression *e* in Schmidt's chart. It is smaller than *h* and *g*, but is a comparatively easy object at sunrise, when the rim is rather prominent. It has been recently recorded by Dr. Sheldon, Mr. Goodacre, and Mr. Mee.



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*h*. This object was recorded by myself, 1890, May 12, and has been seen on subsequent occasions. It lies close under the E. wall and is remarkable for its very dark hue. I was unable to get a satisfactory alignment, but it is shown in its proper position with respect to *h* and *g*. There are no indications of it in the maps.

*l*. This depression, aligning with crater G on the N. wall and *d* on the floor, is easily seen at sunrise. Its shape is peculiar, and appears to be the result of the coalescence of two rings of unequal size.

*m* and *n*. Two depressions, closely associated with the prominent crater *d*, lying, one on the south-east, the other on the north-west side of it. Though *something* is always seen in these positions under a low angle of illumination, it is only seldom that one can trace these objects as they are shown in the accompanying map. They assume, in fact, Protean aspects, which render them very puzzling features. I imagine that the surface round *d* is very irregular, consisting probably of *several* overlapping hollows grouped together; and that the discordance of observations made at different epochs under apparently the same conditions are due to variations in the *direction* of the illumination which, though slight, are sufficient to render the identification of these hollows a matter of considerable difficulty. The crater *d* is shown as standing on the rims of *m* and *n*, but on one occasion I saw it very distinctly *within* a hollow which was regarded as answering to *m*. Schmidt draws a large incomplete ring nearly on the site of *m*, but neither Mädler or Neison show any traces of either *m* or *n*.

*p*. A smaller depression a few miles due S. of the great crater A, distinctly shown both by Mädler and Schmidt, and well seen by Dr. Sheldon, 1894, May 12, $8^h\ 30^m$, and by Mr. G. L. Brown and Mr. G. T. Davis, on the same evening. I saw it under very good conditions, 1890, May 26, $10^h$, and on many subsequent occasions less perfectly. It stands about midway between the crater 21 on the W. wall and the depression *i*.

*r*. This depression is also shown by Schmidt, but neither by Mädler nor Neison. Dr. Sheldon, Mr. Mee, and Mr. Davis saw it, 1894, May 12, between $8^h$ and $10^h$. It is not an easy object. Its position on the map is, I think, fairly accurate. It lies about midway between the crater A and the depression *i*.

## CRATERS.

A, the well-known crater, between four and five miles in diameter, on the north-western quarter of the floor. It is of considerable altitude and has at least one prominent peak on its rim, which may often be seen standing out as a bright point amid the shadow of the great mountain mass $\eta$ on the W. rampart, at sunrise. Careful drawings of the form of the shadow at various stages, both under a rising and setting sun, would be of great use. Members with sufficient optical means might search for traces of a central hill within A, and for craterlets on its flanks.



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*d*, the second considerable crater on the floor, less than half the diameter of A, and far less conspicuous.

1, a conspicuous little crater near the foot of a projection from the south-west wall. Its position, with respect to A and *d*, is fixed by Mr. Maw's measurements, and may be regarded as accurately shown in the map.

2 lies a little east of a line joining A and 1, and appears to have been first recorded by Mr. Maw.

3 lies a little west of a line joining A and 1, and appears in Schmidt's chart.

4, a distinct crater near the foot of the west wall, roughly aligning with Herschel B and Crater A, though perhaps a little east of the line under mean libration. It is rather conspicuous, and is shown by Schmidt.

5, a conspicuous crater about midway between A and the south border, west of a line joining *d* and 1, position not accurately determined. Prominently shown by Mädler.

6, a crater a little east of the apparent centre of the floor. Seen by Dr. Sheldon, 1893, January 25. Position not accurately determined.

7, a crater near foot of north-east wall, aligning with A and *d*. Seen by myself on several occasions, but not prominent.

11, a prominent crater just opposite a gap in the east wall. It is shown by Mädler and Schmidt, and can scarcely escape the notice of the observer at the proper phase. The floor for some distance along the foot of the wall in the neighbourhood of this object is very dark. It lies a little south of a line prolonged through A and *d*. Its position as shown in the map may be taken as fairly accurate.

12, a crater on west rim of the depression *b*.

13, a crater on east rim of the same.

14, a crater a short distance east of the *a*, *b*, *c* group, first recorded by Mr. Maw. Seen since by Dr. Sheldon and myself. Position not accurately determined.

15, a crater about midway between A and 14, and a little east of a line joining them. Seen by Dr. Sheldon, 1893, January 25, $6^h\ 30^m$, by Dr. Paterson, and doubtfully by Mr. G. L. Brown. Position not accurately determined.

16, a crater between *d* and the north wall, nearly agreeing in position with one shown by Schmidt. Seen by Mr. Maw, Mr. Goodacre, Dr. Sheldon, and myself. It lies west of a line joining Herschel B and *d*.

17, a crater doubtfully indicated by Schmidt, seen twice by myself. Position not accurately determined, but nearly as shown.

18, a crater between *d* and the north-east wall (about midway), shown by Schmidt and seen by myself.

19, a crater on the northern edge of *h*. Shown by Schmidt, and well seen by Dr. Sheldon, 1893, January 25.



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20, a crater shown by Mädler and Schmidt, and usually seen without difficulty at the proper phase. It is situated a little south of a line joining *i* and 1.

21, a very large depression on the west wall, near the great mountain mass $\eta$.

22, a smaller but very conspicuous crater on the north wall, west of Herschel B.

23, a conspicuous crater of a similar class to 20, near the border of Alphonsus. It is shown by Schmidt, though omitted by Mädler. Its position is only approximately correct.

24, 25, 26, 27, 28, 29, a group of six little craters situated near south-east corner of the floor. They are not shown in the maps, but undoubtedly exist nearly in the positions given. Dr. Paterson, Mr. G. L. Brown, Mr. Mee, and myself, have seen them, but in the absence of alignments their places must only be taken as provisional.

30, 31, two large conspicuous craters at the foot of the south-east wall, probably identical with two drawn by Schmidt in this position. Visible under a high angle of morning illumination, when the floor is nearly free from shadow. Probably obscured under a lower sun by ridges or other surface irregularities.

G, a conspicuous crater on the north-west border, about midway between 21 and 22.

H, a brilliant little crater on the west wall, south of the gap in the rampart on the south side of the mountain mass $\eta$.

[There are many more craters and depressions on the walls which are not represented on the present map, as their positions are not determined.]

The floor of Ptolemaus, if observed under a very low angle of illumination, is seen to be traversed by a great number of low ridges, most of which appear to affect a meridional direction, and to be closely associated in many instances with the craters and large cup-shaped depressions. In fact, though apparently at other times one of the smoothest interiors, it is in reality more rugged and corrugated than many objects of its class. Until the positions of the depressions and craters are more accurately determined, it is useless to attempt to represent these features. One of the most prominent of these ridges is, however, shown, running from A through 5, 20, and 23, towards the border of Alphonsus, two others, north of *r* and *p*, observed by Dr. Sheldon, are indicated by dotted lines. The first-mentioned ridge, and another crossing it nearly at right angles, running from *d* to crater 1, are shown in a drawing published in the "Journal," Vol. I., p. 308.

The light markings which exist in great numbers on the floor, and of which Mr. A. S. Williams has supplied an elaborate drawing, have not yet received attention from Members of the Section, as it seems desirable at the present stage to strictly confine the work to the observation of less delicate detail. A dark area is, however, shown on the north-east quarter of the floor, as being too obvious to be overlooked, and is represented in many drawings I have received.



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In concluding this somewhat extended notice of Ptolemaus, I would point out the importance in continuing the work of observation,—

(1) Of carefully observing the cup-shaped depressions, whenever they can be traced, *both under morning and evening illumination;*
(2) Of fixing their position either by the micrometer or by alignments with other well-known objects on the rampart, the floor, or beyond the limits of the formation;
(3) Of carefully observing the craters in the same way;
(4) Of noting the association of craters with the cup-shaped depressions.
(5) Of observing and drawing the craters and depressions on the border.

The accompanying map should, in future, be utilised by observers. If an enlargement to double the size is made of it, it may be conveniently used at the telescope, and the necessary additions and corrections inserted. This will ensure uniformity in the size of the drawings, and will be otherwise desirable.

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## Vendelinus.

Since the date of the last Report, attention has been specially directed to the details recorded on the north-west side of this formation between February 13 and November 6, 1892, by Mr. W. H. Maw, F.R.A.S., and published therein. Four of the craters discovered by him on the eastern slope of Vendelinus C were seen by the Director with a power of 284 on a 8½-in. Calver reflector, at $8^h$ on April 9, 1894, and three on the same night, and at about the same time, by Dr. Sheldon, F.R.A.S., of Macclesfield. The former appear to answer to Mr. Maw's *l, n, o, g* (Memoirs, Vol. II., Part II., Plate 1, Fig. 3), and the latter to *l, o, g*. It was not a first-rate night, and they were only seen at moments of best definition, but there is no doubt as to their existence. On the same evening the two craters on the slope of the curious mounds abutting on the eastern side of C were easily visible to me, but were apparently not noticed by Dr. Sheldon, either on this date or previously on March 20, 1893, when a sketch on a large scale was made of Vendelinus C. No additional features have been detected by English observers on the floor, though it has been diligently scrutinised. Herr Krieger, however, records two craters on the S. of D, and draws the crater between it and the more northerly of the two mounds as a double crater, with a winding cleft running for some distance S. of it. Mr. Augustus Freeman, of Brighton, sends a sketch of Vendelinus under morning illumination, in which the summits of these mounds show as bright areas in the midst of the shadow of the W. wall.

The following notes relating to Vendelinus have been received from Herr Brenner:—"1894, July 6, $7^h$ $30^m$ to $8^h$ $30^m$, power "198, terminator through Goclenius. I saw no rill (perhaps on "account of the damp air, the low position of the moon, and the "high illumination), but, on the other hand, I discovered four



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" craters which are not shown on any maps or drawings. Two of " them are very striking objects, even visible with a power of 137 " diameters ; they are in the south-western part of the plain above " and below the letter *e* in Schmidt's chart. The southern of " them is larger than the other one. The other two craters form " a square with the double crater *o* of Krieger's drawing* being " E. of them. In a line between this and crater *h* [D in this " drawing] I saw an object, hill or crater, which I could not see " distinctly enough to settle the matter. [It is evidently the " prominent crater S. of D.] In Schmidt's chart there are several " objects in wrong positions. The double crater, identical with " Krieger's *o*, ought to be more to the W." . . . . " It " surprised me that Krieger saw only *one* of the four craters " N. of *h* (D) (which are shown by Schmidt), and that he draws " a rill coming from this crater. This leads me to suspect that he " observed when libration caused the four craters to appear in a " straight line, and so close together that Krieger fancied it was " a rill. I don't pretend that the rill does not exist." There is no question about this, as it has been observed and drawn very many times by others. It was also noted by Prof. W. H. Pickering at Arequipa, and is classed among his "River-beds." Krieger's drawing of it is particularly interesting when regarded in the light of these observations, as he shows it as terminating in one of the pear-shaped expansions so characteristic of the small river beds.

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## Aristarchus and Herodotus.

Though since the date of the last Report fewer observations than could be wished have been made of these formations and of the serpentine valley connected with Herodotus, drawings have been received from Dr. Sheldon and Mr. Mee, which show many details hitherto unrecorded.

One of these by the former observer, dated 1894, November 9, $8^h$ to $9^h$ $15^m$, showing Herodotus and part of the region north of it as far as Wollaston B is reproduced (Plate II., Fig. 1), with the following notes by Dr. Sheldon.

" 1. Branch to Aristarchus from great T valley.
" 2. Soft dark streak from angle of T.
" 3. Soft dark band between valley and 2, dividing the southern bright from the northern duskier part.
" 4. Bright streak, with a distinct crater at its northern end.
" 5. (To the left of crater), is at north end of dark dense streak under the east wall of Aristarchus, which does not seem to be altogether the shadow of the wall, and sends fainter branch towards crater.
" 6. Shadow of low ridge.
" 7. Bright round spot.
" 8–14. Probably all craters (13 being suspected double), 11–14, almost confluent.
" 15 ? Short rill.

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* This is the double crater on the S.E. side of the floor in Plate II., Fig. 4, in last Report.



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"All features on north converging to B doubtful, delicate dark streaks; at times resembling shadows of low ridges."

2 and 3 represent the valley at the foot of the bright mountain-mass overhanging the western side of the Great Serpentine Valley near its entrance on to the floor of Herodotus, and has been seen frequently by the Director, much as it appeared to Dr. Sheldon on the date of his drawing. As regards the dense streak 5, this is apparently a long, narrow trough-like depression on the upper part of the E. glacis of Aristarchus. It has this appearance under morning illumination when the terminator is about 2° E. of Herodotus. 6. The shadow of the low ridge on the surface of the comparatively level ground between N. side Herodotus and the Serpentine Valley, occupies the site of an object recorded by Gruithuisen as a cleft, though it has never been subsequently seen as such. Under a high light the Director has often seen a faint, light curved streak nearly in this position. The marking running in a south-westerly direction from the crater C is a cleft. No favourable opportunity has yet been afforded for the identification of most of the other minute objects shown in the drawing.

In a second drawing, made 1893, March 29, $8^h\ 20^m$ to $8^h\ 45^m$. Reiner and E. wall of Schickard being on the morning terminator, Dr. Sheldon shows the whole of the Great Serpentine Valley from its commencement at the low mountain-range east of Herodotus to its embouchment on the floor of this formation. The resemblance of this remarkable object to an old river bed is never more striking than at this particular phase of illumination, as its relations to the what appears to be the natural drainage level of the country, as exemplified by mounds and swellings of the surface can be clearly made out. In this sketch a very peculiar modification of the second abrupt bend in its course is shown, which is not represented in any drawing I have seen. The cleft, after its first sudden swerve from S.E. to S.W., as suddenly turns again from S.W. to S.E. again. Dr. Sheldon shows these bends, much as they are drawn in the maps and monographs, but he also represents another cleft as forming an hypotheneuse to the right angled triangle formed by the main cleft enclosing this right angle and joining it. The Director invariably finds that section of the Great Valley which lies a little N. of Herodotus very indistinct and badly defined, notwithstanding its great depth and width. It is very desirable that observers should obtain as many observations of this portion of it as possible in order to discover whether this apparent obscuration always exists under similar conditions of illumination. It is a favourable phase for this purpose when the E. long. of morning terminator is about 55°.

Mr. Mee sends an excellent sketch of Aristarchus, Herodotus, and the surrounding region, dated 1894, January 18, $10^h$, made under good conditions with a power of 200 on his 8½-in. speculum. His drawing is valuable as showing the outline of the continuous band of shadow extending, under a rising sun, from the S. side of Herodotus over the floor of this formation to the N. end of the mountain-mass overhanging the valley near its widest end. He also shows many details on the plain embraced by the valley which have not been hitherto recorded.



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In the recently published "Annals" of Harvard College, Vol. XXXII., Part I., Prof. W. H. Pickering has the following remarks relating to the Great Serpentine Valley, which, with other features of a much more minute type observed at Arequipa, he classes as a "river-bed." "This valley takes its exit from a long "pear-shaped craterlet in the vicinity of Herodotus, and flows first "north, then east, and later south. At its exit it is three miles in "breadth, and is about 120 miles in length. Its apparent dimensions "in a direction at right angles to the limb, near which it is "situated, are considerable foreshortened. When near the "terminator, it is seen that this river-bed originally took its "origin in the crater of Herodotus itself, but that the exit was "closed by a subsequent eruption of black material, nearly "choking up the original valley. This cannot be seen as well "when the sun rises higher, and the valley actually at present "terminates in the pear-shaped crater above mentioned. This "does not seem to have been noticed by Neison, (The "Moon," "p. 272), who connects it directly with Herodotus itself, or, as "he states it, 'it then extends to the foot of the wall of Herodotus, "'passes through in a gap, and ends in a broad mouth in the "'interior.' No such gap is in existence at present, nor pro- "bably has it been for many thousands of years. Although this "formation is many times larger than any other member of its "class, it is not so characteristic in form as some of the smaller "ones, on account of its lacking the zigzag and winding appear- "ance, which seems to have been nearly obliterated by its great "width."

As remarked above, the peculiarly indistinct character of that section of the great valley immediately N. of Herodotus is very noticeable. The Director has a drawing which he made 1891, January 22, 9.30, where the surface for some miles N. of Herodotus is shown as "dark and smudgy," scarcely any trace of the valley being visible, though at a point about midway between Herodotus and the table land it suddenly appears as a broad deep chasm, and so continues.

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## Billy.

It is only with considerable attention and under good conditions that any detail is observed to vary the monotony of the dark depressed floor of this ring-plain, which ranks as one of the darkest spots on the visible surface of the moon, and apparently as one of the smoothest. Careful scrutiny, however, reveals the existence of two small ill-defined spots on the southern quarter of the interior, which, according to some observers, are undoubtedly craters. Dr. Sheldon, of Macclesfield, observing the formation, 1893, October 25, $9^h\ 10^m$ to $9^h\ 40^m$, under somewhat unfavourable conditions, noted the more westerly of these objects as a bright oval spot, and its companion as a very bright oval spot, which at times seemed to be connected with the wall. S. of the pair, he observed a light streak running apparently from wall to wall and forming a chord to its curvature; while a little N. of the centre he remarked a very ill-defined and nebulous light area which was



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only occasionally seen. In his recently published lunar observations, made at Kaiserlautern, Herr Phil. Fauth has a fine drawing of Billy, Hansteen, and the neighbourhood, in which he shows the two spots on the southern side of the floor as distinct craters, but no other detail whatever. In a previous drawing, dated, 1892, May 8, $9^h$ to $9^h$ $30^m$, made when the morning terminator intersected Schickard and the W. wall of Reiner, Dr. Sheldon saw a light area at the extreme southern end of the floor, but no spots or other features thereon. He noted a small but distinct crater on the north-west rampart just below the summit, which, so far as I know, has not been previously recorded as such, though a notch is visible at this stage of illumination in the outline of the wall at this point.

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## Gassendi.

Mr. Mee sends a fine tinted drawing of this magnificent formation, dated 1894, December 8, $5^h$, made with a power of 200, under morning illumination. In addition to three of the principal clefts on the south-west quarter of the floor and many isolated hills, the details of the great central mountains and their shadows are admirably shown, as are also the results of the apparent collapse of part of the north-west wall.

Herr Brenner supplies the following notes relating to Gassendi: —1894, August 12, $7^h$ $30^m$ to $10^h$ $30^m$. "Air boiling (bad seeing), "power 146; terminator, Flamsteed; moon very low. At the "first look I saw a very long rill (*m*) as one of the most striking "objects, beginning between Gassendi A and *b*, and disappearing "in the shadow. Later I was able to see its end, the whole "length and direction being visible in my sketch. Schmidt's rill "(Neison's $\phi$), between the craters C and G, is crossed by my "rill near the letter *i* of Schmidt's chart. It is inconceivable "that so large and striking an object has not hitherto been seen "by anyone else! I compared what I saw of Gassendi with "Dr. Klein's special map, and found that his O looks like a crater; "that near L there is really a crater (possibly also it is double, or "quadruple, according to Schmidt). I was not able to see K and "*p*; N was only marked; P, Q, and R were invisible. Of all "the rills in the interior I saw none (quite natural, if one reflects "under what unfavourable circumstances the observation was "made!). Where there ought to be Rill No. 1 I saw only a low "hill range. . . . . South-east of Gassendi I saw two "parallel rills—the northern one is drawn by Schmidt as a long "crater-rill, while he draws the other one only a short distance "in the middle as a rill—the rest as a hill-range. But to me it "made the impression of a rill." 1894, September 24, $17^h$ $15^m$ to $17^h$ $45^m$, power 198, terminator, Encke. "The rill discovered "last time was not visible; it was only marked in its W. part by "several cuttings through the mountains. These cuttings being "isolated, I understand now that nobody who has not seen the "rill under *other* illumination can suppose it to exist."

[I have not been able to confirm the existence of the cleft E of Gassendi, which was so prominently displayed to Herr Brenner



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on August 12, 1824, nor does it appear on any drawings in my possession, In the years 1883, 1884, much time was devoted to the rills in the Gassendi region, and I found four of those bordering the north-east side of the Mare Humorum comparatively easy objects in a 4-in. Cooke achromatic, power 200. On February 18, 1883, $6^h$ to $8^h$ (W. wall of Mersenius and Herodotus on the terminator), I saw five (roughly parallel) extending from near the Percy mountains, south-east of Gassendi, to the shore line of the Mare S. of Mersenius. The so-called crater-rill of Schmidt, midway between the outer members of the system, is a very remarkable object and appears to resemble one of Prof. W. H. Pickering's "river-beds" rather than a true cleft, the expansions in its course resembling shallow lakes. It requires examination with large instruments under good atmospheric conditions.]

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## Hyginus N.

The following observations of this object, made by Herr Brenner during the months of June, July, August, and September 1894, are given nearly *in extenso*, as, notwithstanding the close scrutiny which it has undergone by many observers using instruments of all sizes, since its discovery nearly 20 years ago, so many hitherto unrecorded details are noted in connexion with it and its surroundings that it is highly important that no pains should be spared in the attempt to confirm them. Herr Brenner states that Dr. Hermann J. Klein induced him to ascertain if changes had taken place, because Herr Krieger had reported that he had seen something, the existence of which in Dr. Klein's opinion was not sufficiently confirmed. He goes on to say, "I, therefore, observed Hyginus, 1894, June 10, from $8^h$ $15^m$ to $11^h$, M.E.T., the air "being perfectly transparent. Used power 414 with an ortho-"scopic eye-piece of Meisner's new construction. I made the "following sketch (Plate II., Fig. 2), at $10^h$ $30^m$. Hyginus N "appeared not so black as Hyginus, but so dark and striking "that it is *quite impossible* to believe it could have been over-"looked till 1877, if it was formerly as striking as now. "(Indeed, with a power of 98 diameters it was a quite conspicuous "black point). Hyginus N is *no crater*, but a large deepening "without surrounding walls. (Its diameter is a quarter that of "Hyginus)." . . . . "Dr. Klein and other observers "maintained that N had a tongue-like projection towards the "S.W.; but in reality there is only a small deepening, *separated* "from N, but in communication with two small black spots, "probably likewise deepenings, by a very thin and faint line of "shadow (4, in sketch). In the opposite direction, N.E. of N, "and separated from it, is a very striking black spot (certainly a "deepening), whose diameter measures one-fourth that of N. "*This deepening is a new formation*, for nobody else has "hitherto seen it, although I saw it with a power of 146! (It is "marked 1 on my sketch), N.W. of N 1 found a hill (2), and "the rill (3) which is here enlarged. It begins at the foot of the "mountains around the so-called 'Schneckenberg,' and goes "south-westward parallel to the dark shadow-line 4, but not so



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"far as this. It is curious that it has also two deepenings, (but "much smaller ones) at the end. S.E. of N is a crater (5), as "large as 1, but a real crater, which is in communication with N by "a very faint rill, and with the large dark valley by a considerable "rill (6). (This valley connects the 'Schneckenberg' with "Hyginus). The crater 5 was first seen by Herr Krieger of "Gern-Nymphenburg two *months* before my observation, and "described to Dr. Klein as a 'dark spot,' which led the latter to "suspect a change. Besides the larger rill 7, and the crater 8 "on the W. declivity of the Schneckenberg, I saw the rill 9 and "10, shown in my sketch; and a rill on the plain in Neison's "map between the letters V and δ. This latter seems to be "identical with the rill discovered by Herr Witt with the 12-in. "refractor of the Berlin 'Urania,' but all the other objects "mentioned are (as far as I know), first discovered by myself. "Of these objects, three, viz., 1, 5, and most part of 4, are "*doubtless new formations, proving new variations upon the* "*moon*, since it is quite impossible that the other large instru- "ments employed 17 years ago in Hyginus observations should "not have shown them, if they really existed at that time. My "other discoveries may have been overlooked or invisible in other "telescopes inferior to mine in defining power. It is interesting "that Herr Krieger made a very careful sketch *two months before* "*my* observation with an excellent 10$\frac{1}{2}$-in. refractor, likewise by "Reinfelder and Hertel. On this sketch I find a very large "shadow marked A in my sketch. This striking object "was *not visible to me*, and I suppose, therefore, that it has "already disappeared, unless it is one of those lunar objects "which are visible for only a few hours (or less), and under a "certain illumination. That Herr Krieger did not see the very "conspicuous deepening (1) is an evident proof *that this was* "*formed in the time between April* 10 *and June* 10. Herr "Krieger drew also two objects similar to my 7 and 8. The "first is probably identical (although not exactly corresponding "with my view), but the crater in Krieger's drawing is too near "the dark valley, and, therefore, it is doubtful whether they are "identical. It is strange that he did not see 6, 1, 9, and 10. "Future observations will certainly prove that there are *continual* "*changes* near Hyginus."

"1894, *July* 22, $12^h$ $45^m$ to $13^h$ $15^m$, power 198, terminator, Theophilus. Hyginus N looked very strange. It was a very faint dark spot, near which another similar spot marked the position of crater 5. Where rill 4 should be I saw a large white spot. The 'Schneckenberg' resembled a target. Seeing not good.

"*July* 23, $12^h \cdot 30^m$ to $13^h \cdot 30^m$, power 414, terminator, Bessel, unsteady definition. The first look surprised me. The appearance of the 'Schneckenberg' was similar to yesterday, but now I could see it very distinctly. The dark spot in the centre of the 'target' proved to be a large crater with two smaller ones at the sides. The first ring round the centre proved to be the shadow of the slopes of the 'Schneckenberg'; the second ring was N and crater 5. These two objects were very distinctly visible. I was surprised to find that crater 5 was to-day *larger*



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*than N.* It looked like a crater, while N certainly is no crater, but a large deepening filled with shadow under low illumination. My rill 3 and the two black points near its end (looking to-day like craterlets) were distinctly visible. To my astonishment I saw a large white spot on the very place where I had seen a black deepening on June 10—the deepening from which the black line 4 proceeds. The two black spots at the end of this black line, I suspected at times. The craters in the neighbourhood were all visible. At times I fancied that I saw rill 6 as a very faint line. The S-like valley was visible as a shallow feebly marked deepening. Where it reaches the 'Schneckenberg' there is a cleft which impresses one that the valley passes through its outer wall. Upon this mountain I saw a crater which was perhaps my crater 8, although it seemed to me as if its position did not quite correspond. To-day's observations prove that all objects seen on June 10, are also visible when the shadow falls in the opposite direction, if the air is good."

"1894, *August* 10, $8^h$ $30^m$.—None of the formerly seen objects visible, not even the S-like valley!"

"1894, *August* 22, $13^h$, power 414, terminator Manilius. It seems that Hyginus N is a deepening with an inclined bottom; otherwise it would be inexplicable how it is that N looks *very black* at sunrise and *white* at sunset. To-day the dark spot has changed to a white one, and near it I see only Herr Krieger's crater (very distinctly seen as such), but nothing of my discoveries. The S-like valley and its ramification (as drawn in Krieger's sketch) were visible to-day.

"*September* 20, $17^h$ to $17^h \cdot 45^m$, powers 313, 314, terminator, Linné B. Where the S-like valley ends in a dell, or cleft, there I saw a crater, and a second one more easterly. My crater 8 was very great and distinctly visible. I saw two dark spots N. of it which could scarcely be N, because they were certainly the west declivities of the Schneckenberg which were not illuminated by the sun, but *which did not cast* a shadow. My rill 3 was a very striking object, and so was also 9, and the craters S. and W. of 4. Where I supposed to be the site of N, I saw only a whitish spot, but, it seemed to me, that I could identify the two deepenings 4."

In connection with these observations, Dr. A. Gordon Paterson, of South Lodge Ascot, writes to the Director under date 1895, February 3. "I was yesterday able to get a magnificent "view of Hyginus, and compared Brenner's drawing in the "'English Mechanic' to see if I could find any of his reported "new discoveries there, but I am sorry to say that either my eye "or my 10-in. Calver, which is a beauty, are quite unable to find "these objects. Have you seen them? I consider I have good "sight, so I am the more dissappointed."

Dr. Sheldon observed the region 1894, May 12, $8^h$ $50^m$, and has forwarded a careful pencil sketch of Hyginus and its surroundings made on that occasion, with a power of 150 on his $4\frac{5}{8}$-in. achromatic, the E. walls of Ptolemæus and Archimedes being on the morning terminator. The spiral mountain, "the Schneckenberg," is shown with considerable detail, three or four little black pits appearing on its S.E. flank, and another a little



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N. of its apparent centre; while on a dusky area E. of the mountain there are two groups of pits running N. and S. and closely parallel to each other. Five craters are drawn in the region between Hyginus N and the W. branch of the great cleft, all of which agree as regards position with larger unnumbered craters in Herr Brenner's diagram, but which are not otherwise noticed in his report. As regards Hyginus N, it is shown as a dark circular spot with a dusky streak running from its W. side in the position of Herr Brenner's streak 4. With the exception of part of the mountain ridge on the N. of Hyginus N, these are all the details shown by Dr. Sheldon in the immediate vicinity, not a trace of any of Herr Brenner's specially noted objects appearing.

Should the existence of these very remarkable features be confirmed, they will, in the light of Prof. W. H. Pickering's lunar observations at Arequipa, relating to variable spots, and to what he terms "river-beds," assume a special interest, and will remove any outstanding scepticism as to recent change in this particular part of the moon; for it is next to impossible that they could have been overlooked by the host of experienced observers who have scrutinized and drawn it so frequently under all possible conditions.

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## Mädler.

In the Second Report of the Lunar Section, pp. 47–49, attention was drawn to this remarkable formation, which was first systematically observed by Birt and Webb. Their observations were mainly confined to the details on the floor, the ridge which, coming from the N., traverses a gap in the border, and a very prominent bright streak on the north-west of the ring-plain; as were also those of Dr. Sheldon, Mr. Corder, Mr. Freeman, and my own, described in the last Report. These features, however, by no means exhaust what is worthy of observation in this very interesting region, for on the surface of the Mare Nectaris on the W. will be found some of the most perfect examples of large low circular rings on the visible surface (which impress one with the idea that they are the relics of once important enclosures which have been covered with the material of the "Sea"), and other suggestive details. Many observations relating to these have been received from Dr. Sheldon, F.R.A.S. To give a general idea of the character of these formations under a very oblique angle of illumination, I have reproduced a sketch [Plate III., Fig 1] made from $10^h$ to $11^h$ $30^m$ on September 17, 1886, with a power of 284 on my 8½-in. Calver reflector, under a setting sun, the terminator passing through Capella and the W. side of Fracastorius. This shows, in addition to numerous low ridges, two large obscure rings presenting a nearly unbroken rampart, with an intervening valley; the interiors of both including low hills and other surface inequalities. There can, I think, be no doubt that these formations are not a mere fortuitous arrangement of the ordinary corrugations and foldings found so plentifully on the lunar plains, but the summit ridges of rings whose lower flanks are covered by a deposit of subsequent date. Dr. Sheldon's drawings, four in number, represent many unrecorded details in connexion with these remarkable objects.

1 p. 4336.



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The most striking of these, made $7^h$ $30^m$ to $8^h$ $45^m$, April 2, 1892, under morning illumination, the E. walls of Catherina and Plinius being on the terminator, shows the rings in my sketch with the double walls and many minute details, including a crater-row between two ridges on the E. side of the larger ring. The fact that this drawing was made under a rising sun, while mine represents these formations at sunset, accounts for minor discrepancies.

Mädler is also an especially interesting formation under a high angle of illumination, on account of the variety it exhibits in the brightness of its walls, floor, and other features in connexion with it and in its vicinity. The eastern rampart, for example, which is very lofty, is barely perceptible under these conditions, while the much lower western border is conspicuously brilliant, and the eastern half of the interior can only be described as decidedly dusky, while the opposite, or western portion of it, and the loftier parts of the ridge which intrudes thereon, are prominently bright.

At this phase the obtuse-angled bright streak on the north-west, first described by Webb, is especially noteworthy. Dr. Sheldon, under date 1894, November 16, $10^h$ $45^m$ to $11^h$ $20^m$, writes:— "The broad eastern portion of Webb's streak is very like a low "ridge to-night; there is a soft graduated shading away from "the sun. I see also a notch on south-east border of Mädler, "also light streaks on the floor, which contains other details "illegible under poor definition." The notch is very evidently a small crater, which appears as a brilliant point at the southern end of the dusky eastern section of the wall under a high light. On the northern side of Webb's streak, in a sketch made at about the same time on November 15, Dr. Sheldon shows a rill and crater row, which, commencing a little N. of Mädler, runs in a westerly direction for some distance, then, turning towards the south-west, runs up to the obtuse bend in the streak, exhibiting a sudden expansion in its width, but again becoming very contracted before it reaches this point. This feature is only shown in part in the sketch made on November 16.

Dr. Sheldon's drawings give many interesting details associated with the ridge N. of Mädler, and with a secondary and much less obvious object of the same class on the W. of it. In that of April 2, 1892, $7^h$, he shows a crater-row on the eastern flank of the latter. In the "Observatory," Vol. X, p. 68, I pointed out that the principal ridge affords a good example of a landslip on its eastern side. Under good definition two or three irregular terraces can be discerned on this side, and an outward extension of the base of the ridge, which seems to be due to a slipping of the material and an accumulation of the débris at the bottom. The best time for seeing this is when the W. long. of the morning terminator is about 12° or 13°. These observations, which have been subsequently confirmed on three occasions, were made with a power of 284.

The shadow of the E. wall of Mädler in Dr. Sheldon's drawing, made under evening illumination on November 16, 1894, is remarkable, as it exhibits a very peculiar scalloped outline. This, I believe, is not due to irregularities on its crest, but to the existence of rounded swellings in the interior.



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It is hoped that Members of the Section will be induced to follow up and extend these observations, relating, as they do, to one of the most noteworthy regions on the moon.

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### Mare Serenitatis.

A complete monograph of this, one of the largest and most interesting of the so-called "seas," showing its elaborate system of ridges and the innumerable craters which figure on its surface, cannot be looked for till much more enthusiasm is manifested in the observation of the physical features of the moon than exists at present, and till more observers, provided with the necessary optical means, are available. With the many excellent photographs, now easily obtainable, to form a basis for the work, and furnishing trustworthy representations of the grosser features, much of the preliminary difficulty of the undertaking would be removed, leaving the accurate determination of the position of some of the principal craters and other objects on the Mare and the coast line to be fixed by micrometrical measurements thus providing points of reference, by means of which the places of minuter craters, &c. could be set down by alignments. Till something of this kind is attempted, drawings of the Mare *as a whole*, resulting from a few nights' observation, cannot be regarded as of any very great selenographical value. Foremost among the attempts to map and catalogue the multifarious objects on the Mare Serenitatis, is, of course, the monograph published by the late W. R. Birt, F.R.A.S., in 1869, which, admirable as it is, does not profess to be more than an embodiment of the results of various observers made at different times, while the outline is merely reproduced from Beer and Mädler's chart. It is, nevertheless, a valuable work which would be of great service in the preparation of a more extended map founded on measurements. It is far too little known, and should be in the hands of all observers who are studying this portion of the moon's surface, if not for the sake of the elaborate map which accompanies it, at least as an example of accurate descriptions of the various objects enumerated and observed at various times by different selenographers. Observers of Linné will find it especially useful. Another map, less elaborate, but on a still larger scale, by Messrs. Joynson and Williams, of Liverpool, was published in the now defunct "Astronomical Register" in February 1869. It was one of the results of the Linné controversy, then exciting very general interest, and evidently induced Mr. Birt to prepare the more ambitious monograph just referred to. This production, most creditable to the care and industry of its authors, represents nearly 200 craters of different sizes on the Mare, and all the principal clefts with their ramifications. The scale of this map is one half larger than that adopted in Beer and Mädler's chart, which formed the basis of the work, the principal craters being carefully triangulated and set down from measures made on the chart. It does not appear, however, that any independent measurements were taken. The smaller craters and additional objects were inserted from eye observations of their positions with respect to the nearest large crater in their neighbourhood.



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During the years 1870–71 the Director devoted some time to a comparison of this and Birt's chart with the Mare, using an excellent achromatic of 4 inches aperture by Cooke, and was able to identify very many of the craters shown on both, and to record others not represented. This investigation made it evident that the 200 or more craters shown by Joynson and Williams by no means exhausted the craterology of the Mare, and that with a larger instrument the number would be substantially increased, if anyone so equipped undertook to work at the subject. Though the Mare Serenitatis is not specially under observation by Members of the Section, three drawings of it under various conditions of illumination have been received from Mr. T. Gordon, F.R.A.S., in which all the more prominent craters are shown, and many of the principal ridges, together with the salient features on the border. Most of these can be identified, but many, from the lack of necessary alignments, cannot with certainty be recognised. The same may be said of a drawing by Herr Brenner, made 1894, June 9, $8^h$ to $11^h$, when, with the object of comparing Neison's map of the Mare with the moon, he found 25 craters and hills more than are shown thereon, though he could not study the whole Mare. He doubts the existence of some of Neison's craterlets, viz., that between N and *d*, Bessel *C*, and two between Linné A and *e*, while others occupy wrong positions. However this may be, we are clearly none of us, in the present stage of our knowledge of the craterology of the Mare, in a position, to speak positively as to the existence or the contrary of any of these minute features, especially if our observations are merely the outcome of one night's observation.

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## Mersenius.

The curious details on the convex floor of this fine circumvallation have not received the attention from observers that they deserve. Hence in great measure the discrepancies in published drawings of the formation. The crater-row which occupies the highest part of the interior and traverses it in a meridional direction is usually an easy object under fairly good conditions, though it is a little doubtful if it has ever been accurately represented in its full extent. It is in part, I believe, a cleft, and would turn out, if examined in a large instrument, to consist of a number of craters standing on one of these fissures. There is certainly a cleft crossing the northern half of the floor from the inner foot of the north-east wall to a crater near the opposite side, which is not shown in the maps, and many other unrecorded features. This cleft was seen by the Director on November 11, 1883, and by Dr. Paterson, on February 6, 1895.

Dr. Sheldon sends a good pencil sketch of the formation under date 1894, November 9, $9^h\ 30^m$ to $10^h$, in which he shows three of the components of the central crater-row, and indicates the presence of a connecting cleft. He also draws some of the features on the north-east side of the floor. In a second drawing, 1894, November 11, $7^h$ to $7^h\ 30^m$, which represents Mersenius under a very high angle of illumination, several bright points are



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shown at various points on the southern wall, Neison's crater on the N. border, and a number of very remarkable light streaks on the floor, some of them being very faint and delicate. They would appear to be somewhat similar in character to those in Fracastorius, and in most instances to be roughly concentric with the border. Schmidt draws two ill-defined light areas of considerable size, N. and S. of the apparent centre of the formation respectively, but nothing similar to the curved narrow markings of Dr. Sheldon. It would be interesting to find if these features are, as elsewhere, associated with craterlets or light spots. One of them certainly appears to lie on the site of the cleft just referred to, on the northern quartern of the floor.

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## Petavius.

A very excellent and elaborate sketch of this walled plain has been received from Dr. Sheldon, in which he shows some unrecorded details, and throws light on the actual nature of other features of a hitherto doubtful character. The sketch is dated 1894, November 14, $9^h$ to $10^h$, and was made under evening illumination, when the terminator traversed Vendelinus C and the centre of the W. wall of the Mare Crisium. It is reproduced in Plate III., Fig. 2. Dr. Sheldon's notes thereon, are as follows:—

1. A far from easy crater, at moments seeming elongated.
2. Query, a crater under south-east wall. It is a round spot with intense shadow; with, I think, a bright W. margin.
3, 4, 5. Difficult objects, probably hills.
6. Is at the angle of a ⌐-shaped and very bright groove of irregular contour, suggesting confluent craters; quite a striking feature.
7. Query, a valley rill, by no means coarse, which seems to divide at the N. end, one component running into shadow of E. wall.
8. Strongly suspected; is a delicate dark line, which seems to continue line of branch of 7, just mentioned, and joins—
9. A faint dark streak which runs up to the great rill. The latter very conspicuously breaks through the inner terrace of the wall, and stops at a valley.
10. An obtuse-angled dark streak connecting the great rill with the north-east wall, looking at moments like a rill itself.
11. A broader dark streak.
12. Another, but shorter.
13, 14. Delicate shadings (especially 13).
15, 16. Look like shadows of low ridges.
17. The same, but stronger.
18. Certainly a small bright hill.
19. An obtuse-angled dark streak.
20. Suspected fine dark streak.
21. Low ridges.

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[Dr. Sheldon's drawing may be usefully compared with a published one of my own made 1885, December 23, $9^h$ to $10^h$ $30^m$, when the W. wall was on the evening terminator. It confirms the existence of most of the objects he refers to, and representing the formation under a lower sun, many of the features which seemed doubtful under a higher angle of illumination exhibit their true character. For example, 7 is, in part at least, a true cleft, and the apparent continuation of its branch (8) on the ficor, and the streak 9 which runs up to S. flank of the great rill is unquestionably a broad ridge. 11 and 12 are also ridges. 19 represents a long trough-like depression.]

*Herr Brenner's Observations*, 1894, June 6, $7^h$ $30^m$ to $9^h$ $30^m$. Powers 146, 198, and 313. Violent wind. "The rill $\delta$ appeared "as a very conspicuous black line, near which I saw very "distinctly Schmidt's craters; and conspicuous also were four "hills or mounts S. of the central mountain, which crossed "the whole plain in an almost straight line. Gaudibert's rill "$\xi$ was very visible, but it is not straight, as drawn in Neison's "Map, but serpentine. Gaudibert's rill $\phi$ is probably identical "with an observed shadow, which I believe to be rather the "shadow between two ridges. Also I hold his S. prolongation "of the rill $\delta$ not to be a real rill, but the shadow in the valley "between the double wall. This supposition is supported by the "fact that this 'southern prolongation' continues N. towards "Wrottesley. In the angle between Petavius and the N. part of "Wrottesley, I saw very distinctly the three craters discovered "by Dr. Weinek on the Lick photographs. His *fourth* I did "*not* see. (Dr. Weinek himself is not sure of its real existence.) "The craters on the S. part of Petavius were easily visible. On "the S. point of Petavius B I saw a black round hole in the "shadow of the wall, which makes me suppose that there is "really Neison's crater, which does not appear in Schmidt's map "and in Weinek's drawing."

1894, July 6, $9^h$, power 146. "I saw a rill running in a N. "direction from the central mountain towards p in Schmidt's "chart, but crossing only the northern half of the interior. No "map or drawing shows this rill (terminator was at Goclenius)."

[In a sketch of the N. part of Petavius, Herr Brenner draws a serpentine cleft (seen June 6) running from the central mountain towards the N.E. wall, E. of the cleft just mentioned.]

## Plato.

It is to be regretted that, notwithstanding Prof. W. H. Pickering's recent observations of the crater-cones on the floor of this formation, in the course of which he has raised a suspicion that changes have occurred in some of them since they were so carefully observed under the auspices of the British Association for the Advancement of Science nearly 30 years ago, no notes or drawings relating to these features have been received, and only two Members of the Section, Mr. Mee and Herr Leo Brenner of the Manora Observatory, have furnished observations having any referenee to Plato. The former has forwarded a very beautiful



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drawing made 1894, January 4, $7^h$ $20^m$, with a power of 200 on his 8½-in. Calver-reflector, which shows the manifold details of the rampart, and the passes and valleys which traverse it, with great distinctness and accuracy. It was made at a phase of morning illumination, when all but two very narrow strips of the floor extending from the central region to the eastern wall were involved in shadow.

Herr Brenner's first observation, made with powers 198, 313, and 414 on his 7-in. refractor by Reinfelder and Hertel, is dated 1894, May 14, $7^h$ $30^m$ to $8^h$. On this occasion he saw "a strikingly large and valley-like rill" in the north-west wall, and again on the following night. On communicating this discovery to Dr. Weinek, the latter informed Herr Brenner that he could recognise the valley in one of the Lick photographs. As Plato is one of the most frequently observed objects, Herr Brenner wonders how so large and striking an object could have hitherto escaped attention. 1894, August 22, $13^h15^m$ to $13^h30^m$ (terminator through Manilius), he made the following notes :—" The " favourable illumination of to-day allowed me to investigate " with full distinctness the rills observed on former occasions, and " I found that there is but one rill near $\epsilon$, parting from crater G, " and ending at a mountain on the north-east. This rill I had " already seen the first time I looked at Plato (May 14, when the " terminator was at Cape Laplace), and the rill being so striking " an object I could not believe that any observer could have " overlooked it; therefore I thought that it was but a particular " configuration of the north-western wall, which, *under a certain* " *illumination*, looks like a rill; but to my astonishment I found, " afterwards, that this rill was *always* visible (*e.g.*, May 15, $8^h$, " terminator at Gassendi; July 12, $9^h$ $30^m$, terminator, Riphæans; " July 23, $12^h$, terminator, Bessel; August 10, $9^h$, terminator, " Bullialdus), therefore it seems to me *impossible* that it was not " seen before, if it had formerly existed. But, nevertheless, it is " a matter of fact that none of all the maps and drawings shows " this rill. Dr. Weinek wrote me that he is able to see it on a " Lick photograph of August 3, 1893. I am most astonished " that even he did not draw this rill in his drawing of Plato, " because I must own that all his drawings of lunar objects after " nature are so wonderfully in accord with nature, that only a " photograph could be more correct. It seems sure, therefore, " that the rill did not yet exist on November 10, 1884, when his " drawing was made. On August 10, it seemed to me that there " were two more rills in the wall of Plato, the one at $\gamma$, the other " near $\zeta$, but on August 22 I convinced myself that it was only " the configuration of the walls which made the impression of " rills. It is very probable that in consequence of the continued " cooling and contraction of the moon, its surface gets new rills, " even in our day. If so, why should one deny, then, the possi- " bility that the great Plato rill, as well as the great Gassendi " rill (which I discovered August 12), are recent formations? " for I don't believe that there is one observer who cannot see " these two objects even with small telescopes. But if it is proved " that these rills are new formations, then there is no objection " to the supposition that all the rills which I have discovered, and



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" which have escaped Schmidt's attention, in spite of their easy " visibility, are *new* formations. And that would be an argu- " ment more in favour of the theory, that there are still yet " variations and changes on the moon's surface, as proved besides " by Klein's, Krieger's, and my own discoveries near Hyginus N."

Most observers who have had much experience in the observation of lunar rills, or who have studied the records of selenographers, from Gruithnisen downwards, will admit that there are anomalies in connexion with their visibility which can hardly be explained except on the hypothesis of actual surface changes. As regards the features seen by Herr Brenner, the valleys in the north-west and N. wall, noted May 14, and the connecting rill; the large valley-like rill on the north-west seem to answer to the wide gap N. of the peak δ, and that on the N. to the opening W. of that section of the rampart on which there is the well-known landslip. Of the connecting rill on the floor I have no record. Hence the formation should be examined with a view to the confirmation of Herr Brenner's observations. It may be said that this object, judging from the accompanying sketch, occupies the site of part of a long narrow light streak on the floor known as "Webb's Elbow." The rill ε, in his sketch, is quite new to me, though I have observed and drawn the details within and without Plato very many times during the past 30 years under all conditions of illumination and with various telescopes. Nor is there a trace of it in the large collection of sketches by different hands which I have collected during an equally long period.

## Posidonius.

An excellent pencil drawing of this formation by Mr. T. Gordon, made at $9^h$, April 23, 1893, under morning illumination, shows the extension of the lower outer portion of the west wall to the west side of Chacornac and the undulating character of the crest of the rampart on the S.W. The gap on the N.E., and the indication of slipping on the inner slope of the wall immediately north of this opening is also very distinctly represented. Two mounds on the floor, west of the prominent crater A, are drawn as craters, and two minute craters are shown just beyond the foot of the border on the S.E., one, the more northerly, appears in Neison's map. Mr. Pope sends a sketch on a large scale of a portion of the S.W. wall under a low angle of morning illumination, showing the interruption in the outline of the shadow, caused by the presence of the mountain mass at the S. end of the inner concentric wall.

It is unfortunate that the very interesting details of this remarkable formation, as also those of Chacornac, which is so closely associated with it, have not been more exhaustively observed. The connexion between the concentric inner wall and the cleft on the E. side, the actual character of the other clefts on the floor, and other features of a doubtful kind require to be examined with high powers under favourable conditions. The interior of Chacornac, with its included clefts, the crater-rill shown by Schmidt, and the ridges on the floor, have hitherto been very imperfectly observed.



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## Schickard.

Dr. Sheldon sends two sketches of a portion of the floor of this formation in the neighbourhood of the large crater C on the E. side of it. Under favourable conditions a rill-like marking may be traced from C to the N. side of the crater A on the southern quarter of the floor. This is, in part, shown in these drawings; and, in addition, a shallow valley running nearly at right angles to the rill towards *i*, and a small crater forming the apex of a nearly equilateral triangle on the N. of a line joining *a* and *c* as a base. About midway between *a* and *i*, Dr. Sheldon shows a faint light spot standing near the E. edge of the curious rectangular dusky area which abuts on the S.W. wall. This was seen by me as a crater cone of considerable altitude, standing on an elevated portion of the floor, 1891, April 20, $9^h$. Dr. Sheldon's sketches were made 1893, January 29, $7^h$ to $7^h$ $30^m$, and 1893, March 29, $8^h$ to $8^h$ $15^m$, with a power of 150.

Herr Brenner observed Schickard, 1894, May 17, $9^h$ to $11^h$, with powers 108, 116. He says, "the bad conditions (violent "wind), gave only the result of the re-discovery of Schröter's "crater ζ in the interior which (according to Dr. Klein) has not "been seen since Schröter's time." [Schröter's ζ is difficult to identify as there is a number of large depressions and crater rows in the vicinity. One of the former, near the inner foot of the N.E. wall and in close propinquity to a depression on the slope, appears to answer to this object. If so, it is by no means a difficult feature. It has been easily seen in a 4-in. Cooke-achromatic, as has also the short crater rill which runs from its S. rim towards the south].

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## Thebit, and the Straight Wall.

Mr. Henry Corder, Bridgwater, sends a fine pencil drawing of Thebit and the neighbourhood under morning illumination (dated May 24, 1893, $9^h$ $10^m$), the straight wall and the stag's horn mountains at the S. end of it being on the terminator (Plate IV., Fig. 1). The interior of Thebit, of Thebit A., the encroaching crater on the E. wall are in shadow, and the extreme eastern section of the rampart of Thebit *l*, a still smaller crater on the wall of A, just coming into sunlight. The details, in the shape of rows of little hills, on the Mare between Thebit and the wall, are carefully drawn. He writes, "I have seen the discussion "in 'Knowledge' relative to the character of the 'straight wall,' "and happened to catch it on the terminator for the first time on "May 24, and was much surprised to find how low it seems. "It appeared as a row of very faint dots, the lower (N) part, "being still invisible, but it formed, as it were, the terminator, "without showing any distinct line either light or dark. I am "very sorry that I was unable to watch it any longer that night, "so as to see how it gradually took its well-known form." The "dots" observed by Mr. Corder are the loftier portions of a very low ridge, which borders the western side of the so-called wall from end to end, or nearly so. There are also some small



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craters in close contiguity with this edge. It is a misnomer to term this formation "a wall." It is rather an immense cliff, more than 60 miles in length, presenting a face of not less than 500 feet in height to the E. It is, in fact, a sudden drop in the surface of the Mare, and thus bears an outward resemblance to "a fault." The brilliant eastern front of this cliff is a beautiful object when on the evening terminator.

Mr. H. Ellis writes, "Neison shows a range of hills roughly "parallel with the straight wall on the other side of Birt. This "appearance it certainly has when the sun is fairly high, but "with a lower sun this range appears to circle round and form "part of an old, semi-obliterated ring-plain, the only gap being "to the N., to which the straight wall is, very roughly, the "diameter."

Mr. Leo Brenner.—The following notes, relating specially to Thebit, have been received from this observer:—"The discussion "about the reality of the rill discovered by Dr. Weinek on the "Lick photographs, induced me to decide the question by careful "observation, 1894, June 25, from 1 to 3 a.m. The moon was "very low, and thin clouds passed over it. I employed, there-"fore, only powers of 313 and 198 (monocentric eye-pieces by "Steinheil). At the first look I saw the crater-rill very distinctly, "but in its southern part it seems to be rather a larger flat "valley. Its northern part, on the contrary, is quite like a "common rill, and more distinctly undulated around the north-"western hill of the interior than Dr. Weinek has drawn it. "Where the rill reaches the northern wall of Thebit it finishes "in a dark crater, which I took for a gap in the first instance, "believing that the rill had broken the wall. The three hills "and the craters in the interior, drawn by Dr. Weinek, are very "striking objects, and I do not know why they were not seen "by previous observers. I did not see the serpentine rill W. of "the crater near the N. wall, so distinctly. I saw it, but it im-"pressed me that its form is somewhat different. On the W. wall "of Thebit I saw a strong rill-like shadow which may be, as "shown by Schmidt, a deepening between a double wall, though "it resembles a rill." Herr Brenner on the same occasion noted a crater close under the N.W. wall, and a central hill in Thibet A, but apparently did not see the minute hill in Thibet *l*. Under date August 22, $12^h$ $30^m$, power 414, he saw Dr Weinek's rill valley with great distinctness, but remarks, "It does not merit "the name of a rill at all, as it only looks like one under a "certain illumination. There are two low parallel hill ranges "whose shadow causes sometimes a rill-like aspect. On the "other hand, I saw that the rill *b*, which I discovered at my "first observation, and which I believed to be a continuation of "Weinek's rill-valley, is really a rill, ending in a crater hole (*c*) "on the top of the wall. Near it, towards the E., I discovered "to-day another small crater (*m*) on the summit of the wall, "above the large interior crater. All other objects, *d*, *e*, *f*, *g*, "*h*, *i*, seen by me on former occasions were likewise visible, and "beside I discovered a crater-rill (*n*) running from the hill *d* "towards the hill *f*."



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## Miscellaneous Observations.

*Arzachel.*—Herr Brenner sends a diagram of this formation under date, 1894, August 9, when he saw all the craters in Schmidt's chart, and some additional ones on the inner slopes of the wall. He states that three of Schmidt's craters on the N. quarter of the floor are hills and not craters.

*Bessel.*—On July 22, 1894, Herr Brenner saw a black spot where Neison has the crater C. He remarks, "It looks like a deepening, similar to Hyginus N'."

*Capella.*—With powers 330 and 395, on July 9, 1894, Gaudibert's crater on the central mountain impressed Herr Brenner "as a real crater, and not as a notch, as Krieger pretends. "Sometimes it seems to me that it has a small craterlet near it."

*Cassini.*—Herr Brenner finds, between A, the large crater on the floor, and the smaller crater *b*, near the inner foot of the E. wall, three little hills. Two of these have been recorded before, and are not difficult objects under a suitable phase. He noted also a little hill under the wall W. of A, and a short cleft running from it up the inner slope of the N.W. wall. He records, likewise, a short ridge extending from *b* to the S.E. wall.

*Clavius.*—A sketch from Mr. A. Mee, F.R.A.S., dated 1894, April 15, $7^h$ $35^m$, shows the northern and western portions of the formation.

*Copernicus.*—Mr. J. J. Pope sends two large tinted drawings of the rampart and floor, made under morning illumination, 1894, December 17 and 18. The form and extent of the shadows of the western wall, and those of the eastern *glacis* are carefully drawn.

*Fracastorius.*—Observing this formation, 1894, June 8, Herr Brenner detected two parallel clefts on the E. side of the floor, near the wall. During a prolonged acquaintance with this object, I have never seen any true clefts in this position. There are some ridges concentric with the wall near the site, which are obvious when the floor is under very oblique morning illumination. A large number of craters are also shown in the sketch accompanying Herr Brenner's notes, but in the absence of alignments it is impossible to identify them.

*Goclenius.*—Herr Brenner finds that Schimdt has drawn that portion of the great rill in the interior too much towards the W., and that it is not so much interrupted as he represents it.

*Guttemberg.*—Two excellent pencil sketches of this abnormal ring-plain by Mr. T. Gordon, F.R.A.S., made 1893, April 20 and 21 respectively. The peculiarly attenuated border of the great ring A on the eastern rampart, and the deep interior of the ring *e* on the north-western border are well shown, as are also the ridges on the floor, and the details on and about the walls.

*Hippalus.*—Herr Brenner writes, "I compared (1894, May 15, "$8^h$ $30^m$ to $11^h$ $30^m$) the drawings of Rudin Hefti (*Sirius*) "and Dr. Weinek with the maps of Schmidt and Neison. "Neison's rill 3 does not cut through a hill (as represented



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" by Hefti), but passes between two hills (as represented by " Schmidt). The rill which runs parallel to that just mentioned, " parting at Agatharchides A, and ending at the most easterly of " the hills just mentioned on Schmidt's map, continues in reality " behind that hill, and ends at the mountains N. of Campanus A. " The hill is also double as large as on Schmidt's map. Hefti's " eastern rill, which passes through Hippalus, is correctly shown, " and is *not* interrupted as drawn by Schmidt and Neison."

*Kies.*—An excellent drawing dated 1895, January 5, $7^h$ $15^m$, by Mr. A Mee, F.R.A.S., with powers 200 to 400. The very irregular altitude of the S.E. section of the narrow wall is clearly shown by the shadows. The middle portion of the W. border appears to be the loftiest on this side of the ring. Some ill-defined light markings are portrayed on the floor.

*Landsberg.*—The crater found by M. Prinz on a Lick photograph was easily seen by Herr Brenner as "an indubitable crater" with a power of 108 diameters. It is drawn by Schmidt as an isolated mountain.

*Linné.*—Herr Brenner's observations of this object have already appeared in the interim report. Under date 1894, December 16, Mr. H. Ellis saw " at intervals a small crater in the " middle of the white spot. The air was not very steady, as the " moon was still low in the sky, and fleecy clouds were about, " which thickened and blotted all out soon after. I saw this " with a power of about 220 on a 12¼-in. With telescope."

*Lohrmann, Hevel, and Cavalerius.*—Herr Brenner observing these formations, 1894, August 14, $9^h$ $30^m$ to $12^h$, saw, in addition to most of the clefts recorded by Schmidt, a cleft on the N.W. side of the floor of Hevel and an unrecorded crater on the N.E. wall. He noted also a cleft running a little S. of Lohrmann A, to Grimaldi *c*, which appears to be a southerly extension of one of the crossed clefts on the floor (he traces this through the S.W. wall of Hevel). S.E. of Lohrmann, he observed a cleft running to the W. side of Grimaldi B, and, from near the same origin, a second running to the W. border of Riccioli; while from a crater near the S.E. wall of Hevel, he detected another cleft trending towards the E. end of the last. Of these two, the Director believes the first is merely a ridge. The latter was observed 1886, January 18, and is undoubtedly a cleft, as he has seen it under favourable circumstances on many subsequent occasions. Herr Brenner observed another cleft of considerable length on the E. of Cavalerius running towards the S.E.

*Mare Humorum.*—Herr Brenner, 1894, July 13, $8^h$ to $10^h$ $30^m$, compared Schmidt and Neison's records of craters on this formation with the moon, and found "that several of Neison's craters " were quite invisible, while others have a wrong position, and " others were seen by me which were not drawn by Neison. " Schmidt has all craters seen by myself, with the exception of " one, but still more of them occupy wrong positions." Herr Brenner sends a map on a small scale of the craters he observed, but does not explain how he satisfied himself as to the errors of position of the craters in Schmidt's and Neison's maps, which is



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certainly not a matter which can be settled on one night by eye observations alone, without measurements.

*Mare Nubium.*—Herr Brenner finds that Dr. Weinek's "Nova" is not a crater, but consists of a group of a least three hills, thus confirming Herr Krieger's observations.

*Messier* and *Messier A.*—Mr. Mee's interesting drawing of this pair, Plate V., Fig. 1, dated 1894, November 15, $11^h\ 30^m$, is valuable as showing details relating to shadows, &c., which, so far as the Director knows, have not been previously depicted. The narrow strip of shadow, extending E. of Messier to the shadow of the W. wall of its companion, is due to a ridge detected some years ago by the Rev. F. B. Allison.

*Tobias Mayer.*—Under date, 1895, January 6, $9^h\ 10^m$, Mr. Mee sends a tinted drawing of this ring-plain under morning illumination. The lofty peak (nearly 10,000 feet) on the west wall and its noteworthy shadow are well shown, as is also the gap in the N.E. border and a smaller breach of continuity on the E. The central mountain—a bright crater, S.W. of the centre, and a doubtful light spot on the N.E. quarter of the floor are also portrayed. The rampart on the N. appears to be associated with buttresses extending some distance beyond the foot of the *glacis*.

*Otto Struve.*—In a drawing of this large enclosure and the neighbouring formation, Otto Struve *a*, Herr Brenner shows many hills and craterlets not recorded in the maps. Many of these have been unquestionably overlooked but were seen by the Director, 1889, February 14, $8^h$ to $9^h$. On subsequent occasions, several of the craters were seen as light spots.

*Piccolomini.*—Mr. G. T. Davis sends a sketch of this formation under evening illumination, made 1893, September 3, $10^h$ to $11^h$, reproduced in Plate V., Fig. 2. It shows the very remarkable character of the S.W. wall, the upper portion of which appears to have collapsed and fallen on the inner slope. In Plate VI., Figs. 1 and 2, the Director has reproduced two drawings of this ring-plain made 1891, December 19, $11^h$, and 1892, January 4, $5^h\ 15^m$, the former under evening and the latter under morning illumination, which will also serve to illustrate its appearance at phases different from that which obtained when Mr. Davis observed it.

*Plinius.*—Mr. H. Corder's two excellent pencil sketches of this formation and the neighbourhood, made 1893, March 23 and April 21 respectively, about $7^h$, show some very interesting details. In the last he draws a rill-like valley between parallel ridges running in a S.W. direction from the cleft δ. The Director has never seen this object, which appears to lie on the site of the E. boundary of the light plateau surrounding Dawes.

*Theophilus.*—In Plate VII., Figs. 1 and 2, are reproduced two drawings of this magnificent object under low morning illumination (1) by Mr. A. Mee, dated 1894, May 10, $8^h\ 15^m$; (2) by Mr. T. Gordon, dated 1893, April 21, $8^h\ 35^m$ to $8^h\ 50^m$.

T. GWYN ELGER, F.R.A.S.,
(Director of the Lunar Section).

Bedford,
1895, May 1.



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## TOTAL ECLIPSE OF THE MOON, 1895, MARCH 10.

The total eclipse of the moon on March 10 will long be remembered by all who saw it as one which throughout the greater part of England was visible from beginning to end under the best possible conditions; and, as will be seen from the following notes, exhibited phenomena of great interest, relating to the distribution and intensity of colour displayed during the various stages of its progress.

Both as regards these chromatic appearances, the density of the shadow, and the obscuration of the moon during totality, it bore a great resemblance to the total eclipse of August 23–24, 1877.

The following reports, placed in the order in which they came to hand, are from :—

MR. G. T. DAVIS, Reading.
DR. A. GORDON PATERSON, Ascot.
MR. H. ELLIS, Potters Bar.
REV. W. R. WAUGH, F.R.A.S., Portland.
REV. T. H. FOULKES, M.A., Devonport.
MR. J. EVERSHED, Kenley, Surrey.
MR. J. H. R. SALMON, Croydon.
MR. W. GODDEN, West Hampstead.
MR. C. A. TAYLOR, 33, Argyle Street, Argyle Square, W.C.
MR. T. GWYN ELGER, F.R.A.S., Bedford, (Director of Section).

MR. G. T. DAVIS :—

*Disappearances.*

| | h | m | s |
|---|---|---|---|
| τ Leonis - - - | 14 | 55 | 10 |
| W.B. XI. 349 - - | 14 | 55 | 20 |
| W.B. XI. 365 - - - | 15 | 12 | 30 |
| W.B. XI. 372 - - | 15 | 34 | 20 |

B.D. + 3° 2501 would have been too faint to observe, even if moon had still been visible. At 15·50 it could only be seen by glimpses.

*Re-appearances.*

| | h | m | s | |
|---|---|---|---|---|
| 83 Leonis - | 15 | 12 | 0 | Almost seemed to shoot out. |
| $P_1$. XI. 71 - | 15 | 12 | 50 | |
| B.D. + 3° 2501 - | 15 | 17 | 50 | This was seen before, but so faintly, that it was only at this time when wide of the limb that it was recognised. |
| τ Leonis - | 15 | 44 | 55 | |
| W.B. XI. 349 - | 15 | 47 | 25 | |

The moon at $14^h\ 40^m$. Gray on N. part of disk in shadow, the rest coppery.

| h | m | |
|---|---|---|
| 14 | 44 | Edge of shadow on Proclus. |
| 14 | 45 | ,, ,, Atlas. |
| 14 | 46 | ,, ,, Picard. |
| 14 | 50 | ,, ,, W. edge of the Mare Crisium. |



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14 47 Shadow coppery, except about one-third of width of shadow on disk, next the edge of shadow, which appeared grey.

14 53 Totality began, disk shaded all over in telescope ($3\frac{3}{4}$ O.G., eyepiece 65, used for all observations). E. part very dark grey, S.W. coppery, lighter tinge round rest of disk.

15 0 Aristarchus, Menelaus, Manilius, Proclus, distinguishable as bright spots. The dark grey nucleus of shadow on E. part of disk. Round W. edge, almost chrome. S.E., decided coppery tinge. In the telescope it appeared greyer with only faint colouring.

15 20 Colour scarcely discernible in telescope, and no formations could be made out. Dark nucleus more central, rest of disk coppery, which was most intense on the S. part.

15 30 The nucleus of shadow seemed central; lighter, with coppery tint all round disk. To eye, general copper colour with dark centre.

15 50 The nucleus of shadow now seemed to touch W. limb; brighter round rest of edge, which appeared light coppery to the eye. Moon now close to my horizon.

The darker nucleus of shadow seemed somewhat elongated, E. and W., and was somewhat undefined in shape. But when touching either edge of disk, appeared somewhat cone-shaped, with base on edge of disk. It obliterated all detail within its bounds.

The moon was always very easy to see with the naked eye, the nucleus having only about one-half the diameter of its disk.

Time taken by watch set right on Saturday. Clear sky, 8° of frost, and very slight wind.

At $15^h\ 24^m\ 30^s$, a fine meteor fell slowly from some point below, $\pm$ 2° W. of Arcturus to $\pm$ 2° E. of Spica, about equal to Saturn, golden, pear-shaped, and left a slight trail.

Sky clear. Slight frost.

DR. A. GORDON PATERSON.—"I had a good view of the greater part of the eclipse and send you a few notes of appearances to my eye. I did not take the exact time of contact either of penumbra or shadow. I got the times of eight stars, having obtained exact Greenwich time from my meridian instrument, as given below. The colour of the shadow on the moon was most varied and striking. I made a drawing near totality and one just after, showing tints of the shadow. Taken as a whole the S.E. quadrant was reddish yellow, and the N.E. and N.W. dark slate blue. The edge of the shadow was apparently uneven all along and showed a distinct but faint shading off. The white point Aristarchus was visible almost till quite the phase of totality. Tycho and ray-system visible all through. The disappearance and reappearance of stars was absolutely instantaneous, and the reappearance of $\tau$ Leonis beautiful and striking. I was almost certain that for a considerable time before the contact of shadow the penumbra sensibly increased in density. While looking at the



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moon for some time before the eclipse, I saw several dark bodies flit across its disk in the manner of meteors, and all from S.W. to E."

*List of Stars.*

| — | Time by comparison to Observatory. | Observed Time. |
|---|---|---|
| | h m s | h m s |
| 83 Leonis D | 14 17 0 | 14 17 18 |
| Pi XI. 71 D | 14 18 0 | *14 17 56 |
| τ Leonis D | 14 56 0 | 14 56 06 |
| W.B. XI. 349 D | 14 57 0 | *14 56 26 |
| Pi XI. 71 R | 15 13 0 | 15 13 01 |
| W.B. XI. 372 D | 15 36 0 | *15 34 46 |
| τ Leonis R | 15 43 0 | *15 44 28 |
| W. B. XI. 349 R | 15 48 0 | *15 47 56 |

"I am quite sure of the times marked *, though they differ from the computed times. My stop watch was set as near absolute correctness as it was possible."

MR. HENRY ELLIS.—"The night of the eclipse was very clear here till 5 a.m., but the air was not so steady as it might have been. I could detect no irregularity of the edge of the shadow, which was not well defined or sharp, the colour of the moon when covered by shadow was very pretty,—the S. portion being golden copper, the Maria being a darker sort of violet, I suppose by contrast, and a narrow band of light, gold colour, round the N. half of the circumference of disk. The formations were seen in all parts of the disk.

| | | h m s |
|---|---|---|
| 83 Leonis | Disappeared | 2 18 19 |
| Pi XI. 71 | „ | 2 18 56 |
| τ Leonis | „ | 2 57 4 |
| W.B. XI. 349 | „ | 2 57 7 |
| Pi XI. 71 | Reappeared | 3 13 48 |
| W.B. XI. 365 | Disappeared | 3 14 30 |
| W.B. XI. 372 | „ | *3 36 9 |
| τ Leonis | Reappeared | 3 44 30 |
| W.B. XI. 349 | „ | 3 48 13½ |

| | h m |
|---|---|
| Shadow was off Aristarchus | 4 33 |
| Shadow crossed Kepler | 4 39 |

"The times were taken by watch which was 1 minute 18 seconds fast by Greenwich time-signal at noon, March 11th, and fast by same at noon, 1 minute 22 seconds, March 12. At $2^h\ 20^m$ the shadow was all smoky,—no ruddy colour,—the shaded limb being visible to the naked eye, but not in the finder of the telescope, when it was plainly visible at $2^h\ 30^m$. When the shadow was about half way across the moon, I fancied the S. horn of light was blunter than N. horn.

* Disappeared and reappeared for about 1 second.



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"I took some photographs during totality but have not yet developed them."

THE REV. W. R. WAUGH, F.R.A.S.—"I saw the penumbra 10 minutes earlier with the unaided eye than with the telescope. Recorded times—eye $13^h\ 25^m$, telescope $13^h\ 35^m$. Thought the 'Companion to the Observatory' time of first contact with the umbra to be $5^m$ late.

"The beginning of totality seemed also $5^m$ late by 'Companion' time.

"Observed disappearance of 83 Leonis, Pi xi 71, $\tau$ Leonis and *Comes*, viz., W.B. xi 349, W.B. xi 365, W.B. xi 372; reappearance of 83 Leonis and *Comes*, B.D. + 3° 2501. Times about as in 'Companion.'

"The edge of the umbra seemed too ill-defined for recording times of contact with formations.

"The formations were not well seen, except the Maria, which were well defined throughout. Could not discern during totality even Aristarchus.

"The southern hemisphere was of a bright coppery colour. The northern hemisphere a bluish grey. The Maria a dark grey. The difference in colour between N. and S. was very marked, but the line separating these differences was indefinite.

"During totality the stars shone very brightly, stars of the 6th mag. being clearly seen with the unaided eye. The air was good and steady throughout, and the definition on Saturn and the star disks first class.

"The whole phenomena were very striking, and the general aspect of the moon was grandly weird and impressive. All the observed occultations were instantaneous."

The REV. T. H. FOULKES, M.A.:—

*Weather.*—Fine from beginning of eclipse to about 3 a.m.; then hopeless sea fog obscured everything and rendered further observations impossible.

*Penumbra.*—Invisible in telescope till appearance of shadow; visible, easily, in finder, field glass, and with naked eye within quarter of an hour after commencement of eclipse; colour, light brown, like house smoke; density, very thin.

*Shadow.*—Soon after its first appearance, a very striking mass of *colour* showed itself in S.W. quadrant. It seemed like burnished copper, red hot. In my opinion it had a kind of undulating motion, a sort of flickering, very faint, but distinctly visible. The unsteady air may have caused it, but I am inclined to think it originated in itself. Perhaps it might have been caused by the many contrasts of light and colour which abounded just there. This colour was maintained at about the same density, extending itself somewhat in N. direction till totality, when observations ceased.

In N.W. quadrant, at N. angle of it, there ran from the preceding edge of shadow two or three horn-shaped rays of steel-grey light, curving with the lunar limb in N.W. direction, the widest, longest, and brightest being near the N. portion of the moon. Both colours increased in brightness as the shadow advanced.



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Lunar details, especially the "Seas," were distinctly visible through these colours, but craters seemed somewhat obscured by them.

When the shadow was well on disk, ± 2.15 a.m., I observed distinctly, and for the first time, two wedge-shaped protuberances projecting from p. edge of the shadow right through the penumbra on to the brighter portion of moon. They looked like "shadow cones," or shadows caused by mountains.

They were about half as long again as the orbit of the penumbra and stretched in an easterly direction.

In colour they were not so dark as the shadow, but darker than penumbra. The southern one was the larger.

They were first seen ± 2.15 a.m., and grew more distinct and bolder till about 2.30 a.m. when they seemed to diminish and dwindle away, till very soon after 2.30 I lost sight of them altogether.

I thought at one time they were simply parts of the lunar surface, but it was not so, *as they* moved with the advancing shadow.

I looked for other "shadow cones," but saw none. The northern "cone" passed just above "Plato," and I hoped it would have gone over the crater, so as to be able to compare colours, but we missed its *occultation*.

τ Leonis well and beautifully seen. My chronometer gave me 2.53 a.m. for disappearance of the fifth magnitude star. It vanished with a startling *flash*. I saw six other stars occulted, some very small, and two reappearances, but fog and mist spoiled these observations.

The crowds of stars rendered visible by the obscured moonlight was a very striking sight.

It was most unfortunate that bad weather came on just at the most interesting moment.

But in spite of this it was a grand and all-repaying sight.

MR. J. EVERSHED.—The eclipse was well seen at Kenley between 2.50 and 4 a.m. on March 11, the sky being exceptionally clear. At about 3 o'clock the last traces of direct sunlight seemed quite gone from the moon's disk, but there remained a beautiful red glow diffused over the S. preceding quadrant, whilst the N. limb appeared greenish by contrast. The upper and following portions of the disk were more obscured.

In a 3-inch telescope magnifying about 12 times, the whole surface of the moon stood out clearly on the dark sky, and for some reason one had a most vivid impression of its spherical form, several occultations were beautifully seen as the great round ball drifted on among the stars.

The brightness of the red light on the lower portion of the disk suggested the use of a spectroscope to discover, if possible, the nature and origin of this illumination, but the result was unsatisfactory on account of the feebleness of the spectrum obtained, in which no lines of any kind could be made out. In one respect, however, I think the observation was conclusive. It occurred to me at the moment that possibly the light was due to a large solar prominence which had been noticed the previous



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afternoon, extending to a height of about 100″ above the sun's western limb, the light from which would fall within the true shadow cone, and thus illuminate the moon. But the absence in the spectroscope of the characteristic prominence line C, and the presence instead of a continuous spectrum at the red end showed that this prominence had certainly nothing to do with the red tint on the moon. It is clear, too, that any illumination within the shadow cone due to this particular prominence should have appeared just within the *eastern* border of the shadow, and would not have appeared on the moon at all during the earlier stage of the total phase when she would be immersed in the western side of the shadow.

It would be interesting to know what tints were seen when the moon began to emerge from the eastern side of the shadow, because the prominence on the sun at the time was a bright one and must certainly have illuminated this part of the shadow. At Kenley clouds interfered after 4 a.m., and observations were stopped. The prominence was again examined soon after sunrise, and found to be little changed in form or brightness, and a chain of smaller prominences had developed near to it.

I believe it would be possible with a lens of moderate aperture and relatively short focal length to successfully observe the spectrum of the eclipsed moon. If, as seems probable, the light is derived from sunlight that has passed through the air round the limb of the earth, so to speak, the oxygen group B and the other telluric lines or groups of lines ought to be strongly marked, as in the spectrum of the sun when at the horizon. They might, perhaps, be photographed with plates made sensitive to green and yellow light, for the exposure could be prolonged for an hour or more. If this could be done, the question of the origin of the light seen during eclipses would no longer remain doubtful.

Owing to the unusual transparency of the air during this eclipse the Milky Way in the E. showed up beautifully, even down to the horizon, and crossing it between Sagittarius and Ophiuchus, I thought I detected a faint light of quite a different texture. I find, on reference to a star map, that this was situated a little N. of the ecliptic, and about 90 to 100 degrees from the sun's place at the time. Could it have been the western extension of the zodiacal light? This phenomenon has been brighter after sunset this year than I have seen it previously. Thus, on February 16 and 17, at 8 p.m., I could trace it to a point some 85 degrees to the E. of the sun.

Mr. J. H. R. SALMON.—Instruments employed, 12½-in. reflector, 2-in. refractor, field glass.

| h | m | |
|---|---|---|
| 12 | 50 | Temperature (4 feet above ground) 31 Fahrenheit; moon shining very brilliantly; no stars below 3 mag. in vicinity of moon seen with eye. |
| 13 | 11 | Temperature 29 Fahrenheit. E. limb of moon seen in refractor to be very slightly shaded, and of a yellowish tint. |
| 13 | 15 | Shading mentioned above not now seen. |
| 13 | 20 | Shading again seen as at 13.11. |

1 p. 4336.



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h m

13 34 Temperature 29·6 Fahrenheit. Refractor showed yellowish tinted penumbra from E. limb nearly to Copernicus.

13 43 Penumbra as above now seen with eye.

13 56 Temperature 29·8 Fahrenheit. Shadow now very distinct, and touching E. edge of Grimaldi; its edge was blurred and its colour leaden, whilst formations clearly showed through it in reflector.

14 0 83 Leonis, Pi xi 71, and Tau Leonis, with its 7 mag. companion, now brilliant objects in reflector.

14 2 Grimaldi plainly seen through shadow.

14 3½ Shadow round E. limb of moon much lighter than elsewhere, giving the same appearance as is seen during earthshine on a new moon.

14 6 Above appearance plainly seen by eye.

14 10 Aristarchus well in the shadow, and shining plainly, with streak of light towards E.

14 13 Shadow touching E. edge of Copernicus. S. portion of shadow much the lightest.

14 18 Occultation of 83 Leonis; *very* sudden extinction.

14 19 Occultation of Pi xi 71, extinction not quite so sudden as 83 Leonis.

14 23 E. limb copper red to eye.

14 30 Temperature 27·5 Fahrenheit. Penumbra just discernible in refractor. Shadow touching E. edge of Plato. Outline of shadow circular, but with sharp bulge near centre.

Colour of S.E. portion of shadow *copper-red*, of NE. portion, *blue-grey*. Formations showing clearly through shadow, the rays from Tycho quite brilliant in reflector.

14 41 W. edge of shadow *lead-blue*, elsewhere *copper-red*.

14 43 Temperature 28·0 Fahrenheit. Lunar formations distinctly seen with eye through shadow. Reflector showed a mountain (through shadow) projecting from near S. pole. Brilliant meteor fell W. from Ursæ Major.

14 50 Halo round moon, faint stars near showing plainly meanwhile.

14 57 Occultation Tau Leonis. Companion 16 seconds after primary.

15 1 to 15 6 Photographic plate exposed in camera with R.R. lens gave no result on development, although moon showed plainly on screen when focussing.

15 2 Dividing the moon into four quadrants and carefully observing with reflector, refractor, field-glass, and eye, my determination of the colour of the shadow was—

1st (N.W.) quadrant, *pale greenish-blue*.

2nd (N.E.) quadrant, *dark brown-red*.

3rd (S.E.) quadrant, *bright copper-red*.

4th (S.W.) quadrant, *yellowish-red*.



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### GENERAL REMARKS.

Sky perfectly clear during the whole time of observation, except for a few seconds about 14.5o.

The re-appearance of Pi xi. 71 and 83 Leonis was noted as being in both cases as sudden, but the times were not taken.

The times given are approximate only, as I was working single handed, but I think 10 seconds would well cover any error.

My impression is that the *colour* of the shadow was *the* feature of the phenomenon, and the beauty of the varying tints will not easily be forgotten by those who were fortunate enough to see it.

MR. W. GODDEN.—The following features during the progress of the phenomenon struck me as being of exceptional interest :—

Observing with a 3-in. refractor, and employing a power of 80, so early as $2^h\ 3^m$ a.m., the eclipsed limb of the moon showed very distinctly, whilst the small part of disk, then within the shadow, was absolutely invisible. By $2^h\ 22^m$ the limb had ceased to be visible about the eastern extremity, but it re-appeared at $2^h\ 34^m$.

A very dense band formed the preceding edge of the shadow, similar to that I noted in connexion with the partial eclipse of May 11, 1892. This reached Aristarchus about $2^h\ 8^m$, but it was not dense enough to obliterate that object, which continued visible for fully five minutes, and was finally lost sight of where the shadow seemed much less dense.

A more or less decided coppery hue characterised the shadow as seen by unassisted vision throughout the progress of the phenomenon; whereas, and a similar thing was noted on May 11, 1892, in the telescope, the predominating colour was of a greenish-blue combination.

Then, again, the shadow appeared much more transparent to the naked eye than it did at any time in the telescope.

During the total phase the central portion of moon's disk appeared to be covered by a much denser shadow than that which lay upon the margin.

What percentage of what was seen was composed of the shadow of the earth; and what percentage was formed by the shadow of our atmosphere ?

MR. C. A. TAYLOR.—The total lunar eclipse of March 11, 1895, was marked by the very clear sky, which remained free from cloud of any kind during the time in which it was possible to make observations. The first indication of the approach of the eclipse was a very slight darkening of the limb in the third quadrant, which was distinct to the naked eye at $1^h\ 38^m$ a.m. This darkening extended rapidly, the outline being faint, and it seemed that the bright portions of the surface covered by the penumbra formed a good mean in brightness between the darker portions, also in the penumbra and the brighter regions not then obscured. At $1^h\ 52^m$, the region about Grimaldi became very dark, and an apparent flattening of the limb took place at $1^h\ 53\frac{1}{4}^m$, which was well seen.



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The point of contact of the shadow I estimated as being opposite Lagrange, thus giving as the approximate position angle of contact 124°.

The umbra throughout the eclipse was diffuse at the edge, which was darker than the interior part, this diffuseness of the edge rendered the observation of the time of bisection of craters by it of such difficulty as to cause an error of many seconds in the observed time of bisection to be easily made. The first reddish tinge in the umbra became visible at $2^h\ 12^m$, and this deepened in tint until $6^m$, later the well-known rich copper hue was quite distinct; the edge of the umbra was a dull grey with a green tint in it, while at $2^h\ 43^m$ a blue tinge was also noticeable, the contrast between the colours, from the copper which shaded through brick and orange to blue and grey-green, was very beautiful. There was nc irregularity in the curvature of the umbra observed, and the disappearances and reappearances of the stars was instantaneous, the telescope used is 2-in. alt. azimuth, with powers 45 and 135; a light pair of field-glasses was also used; no trouble has ever been experienced with dewing; the tube of the telescope is of wood. All observations were put a stop to at 4.30, owing to the interference of houses with the view.

Observations on crater contacts and bisections:—

| | h | m | s |
|---|---|---|---|
| Aristarchus (reached) | 2 | 8 | 44 |
| Copernicus (bisected) | 2 | 13 | 19 |
| Tycho „ | 2 | 13 | 34 |
| Cape Laplace (reached) | 2 | 23 | 14 |
| Plato (bisected) | 2 | 29 | 11 |
| Menelaus (reached) | 2 | 31 | 5 |
| Pliny „ | 2 | 33 | 54 |
| W Argaeus „ | 2 | 36 | 44 |
| Pickard „ | 2 | 45 | 23 |

*Occultations of Stars.*

The position angle of disappearance of 2 was 45° as a rough approximation.

| | | h | m | s | | h | m | s |
|---|---|---|---|---|---|---|---|---|
| (1.) | Reappearances calculated from two observations of distance | | | | | 3 | 13 | 13 |
| (2.) | Disappearance | 2 | 55 | 56 | Reappearance | 3 | 33 | 37 |
| (3.) | „ | 2 | 55 | 56 | „ | 3 | 37 | 33 |
| (4.) | „ | 2 | 13 | 18 | „ | 3 | 58 | 5 |
| (6.) | „ | 3 | 34 | 49 | | | | |

(5.) This star was faint, and was missed.



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The times have been calculated from those observed by a watch, the error of which was determined from post office time on Sunday evening and Monday morning.

Mr. T. GWYN ELGER, F.R.A.S. (Director of the Section).—The eclipse was observed here under favourable conditions from beginning to end, a cloudless sky, an undisturbed atmosphere, and (for the season) a mild temperature. The following notes made with a power of 50 on my 8½-in. S.O.G. reflector, are supplemented by other observations with the attached finder, magnifying about 12 diameters, and with the naked eye :—

| h | m | |
|---|---|---|
| 13 | 52 | Shadow advancing on S.E. limb. Colour dark smoky grey, very dense, with a wavy ill-defined edge. Penumbral fringe very evident. |
| 14 | 8 | Edge of shadow through Bullialdus and Aristarchus. Colour dark. Limb everywhere traceable, but more easily so on the S.E., where the shadow is notably more transparent. No details visible on the eclipsed surface. |
| 14 | 11 | Shadow through Delisle and Purbach. Very transparent in the neighbourhood of the S.E. limb; elsewhere very dense. No formations visible, not even Aristarchus. |
| 14 | 18 | Shadow through Prom. Heraclides, and Stöfler. The more transparent area near the S.E. limb is of a dirty yellow hue, contrasting with the mouse-grey tint of the rest of the umbra. The great walled enclosures, Schickard and Bailly, just traceable. Aristarchus seen, but with difficulty. Penumbral fringe very marked. |
| 14 | 28 | Edge of shadow through Plato and Piccolomini. Transparent area on the S.E., extending and becoming more prominent every moment. Colour, orange yellow. Many formations in the S.E. quadrant visible, but Copernicus and Aristarchus only seen with difficulty; a greater part of N.E. quadrant very dark. |
| 14 | 34 | Shadow through Cassini and Fracastorius. The orange yellow area now covers nearly the whole of the S.E. quadrant, and a narrow light strip is noticed on the N.E. limb, extending from the region N. of Plato to, say, N. lat. 40°. The latter formation and the outline of the M. Frigoris are easily traceable, but no other features in this quadrant. |
| 14 | 40 | The light area of the S. hemisphere now extends N. of the equator, and is assuming a more ruddy (brick-red) hue. It is so transparent that most of the well known lunar features can be traced through it. The rest of the shadow is unequal in density, but may be generally described as dark |



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h m

slaty-blue. Light strip on the N.E. still noticeable. Plato, the M. Frigoris, the Alps, the Carpathians, and faint traces of Aristarchus and Copernicus, just visible.

14 48 Shadow through W. side of M. Crisium.

[At this stage, just before totality, the moon was an especially beautiful object, both in the finder and to the naked eye, by reason of the contrast between the ruddy hue of the S. hemisphere, the dusky indescribable tone of the N. hemisphere, and the illuminated sickle of light, rapidly becoming smaller and smaller on the N.W. limb. The effects of irradiation were well displayed—the sickle portion appearing to form part of a larger sphere than the eclipsed moon. The moon seemed to be egg-shaped, and, with the brilliant sickle representing the cup, suggested the form of an acorn.]

15 10 The whole of the S. hemisphere, and a considerable area N. of the equator, is of a lovely rose colour, notably lighter than the rest of the disk. This contrast is partly, but not wholly, due to the character of the lunar surface covered by the shadow. A great portion of the southern hemisphere, especially the S.W. quadrant, consisting of much brighter ground. The M. Crisium, Serenitatis, and some other "Seas" are just traceable, but, with all attention, I cannot recognise any formations of a smaller class. Tycho rays visible.

15 28 Only positions of principal "Seas" traceable. Ruddy tint extends still further towards N. limb, and is becoming general.

15 37 The whole disk obscure (colour very ruddy), except on the N. and N.E. limb, where it is notably lighter, so much so that the Mare Frigoris and the Sinus Iridium are clearly seen.

15 47 All the N.E. portion of the moon much lighter than the rest. Aristarchus shining like a star, and several other formations, Copernicus, Kepler, Grimaldi, the Tycho rays, &c., recognisable.

15 54 The whole of the region bordering the E. limb of a light dirty yellow hue, the remainder of the disk dark ruddy (darkest on the W.).

[This distribution of colour very easily seen in the finder and with the naked eye.]

16 5 The yellowish tinge now extends from the S.W. limb round the E. limb to the N.W. limb, and includes a greater part of the E. hemisphere, leaving only a very ruddy dusky area which extends from the W. limb to a little E. of the centre of the disk.



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h m

Tycho with the rays very distinct, as are also Copernicus, Kepler, Aristarchus, &c. Nothing traceable within the dusky area.

16 11 Detail easily visible on the E. hemisphere, but scarcely traceable W. of the central meridian.

[With the naked eye, at $16^h\ 23^m$, nearly all the disk on the S.W. side appeared very ruddy and dark, this colour extending to the centre, the remainder being a much lighter shade of the same colour.]

16 25 Edge of shadow a little E. of Grimaldi, which is distinctly seen within its border.

16 31 Edge of shadow fairly well defined. Shadow generally a very dark greyish-blue, except on the N. and S. limb, where it is bordered by light yellow strips which extend some distance on the disk. Detail only seen with difficulty.

Subsequent notes from this time to the end of the eclipse show that in the telescope the darker portions of the umbra appeared to be more of a greyish-blue than of the ruddy tint which characterised it during the total phase; and, if possible, the ring-mountains and Maria were less easily recognised in the various phases after totality than before totality.

The occultations of $\tau$ Leonis, W.B. xi 349, W.B. xi 372, W.B. xi 365 were noted, but nothing abnormal was remarked, the disappearance in each case being apparently instantaneous.

T. GWYN ELGER, F.R.A.S.,
(Director of Lunar Section).

1895, March 24.

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Since this Report was read, very successful photographs of certain phases of the eclipse have been received from Mr. A. E. Salt, Thornton Heath, and from Mr. Henry Ellis, Potters Bar.



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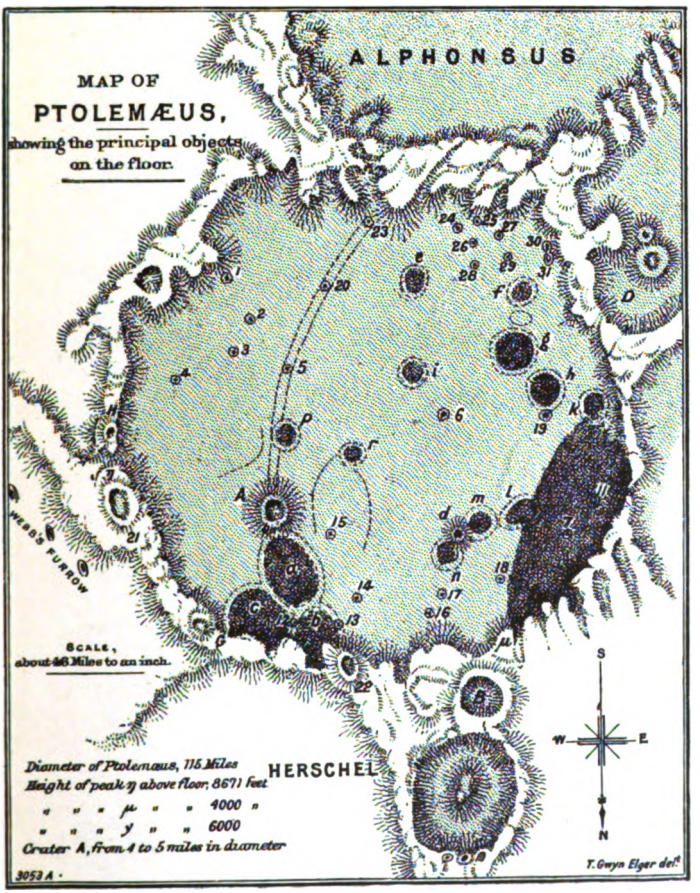


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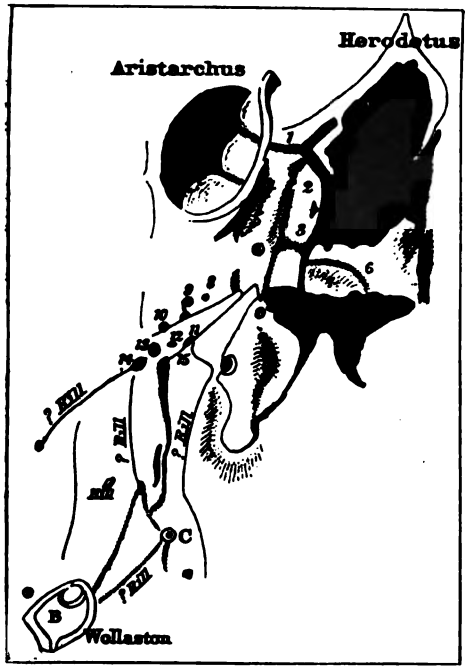


FIG. 1. ARISTARCHUS AND HERODOTUS
(1894, November 9, 8 h. to 9 h. 15 m.).
*By Dr. T. Steele Sheldon, F.R.A.S.*

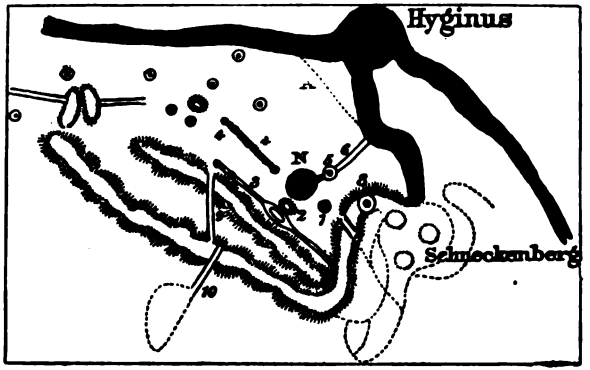


FIG. 2. HYGINUS N.
(1894, June 10, 10 h. 30 m., M.E.T.).
*By Leo Brenner.*

PLATE II.

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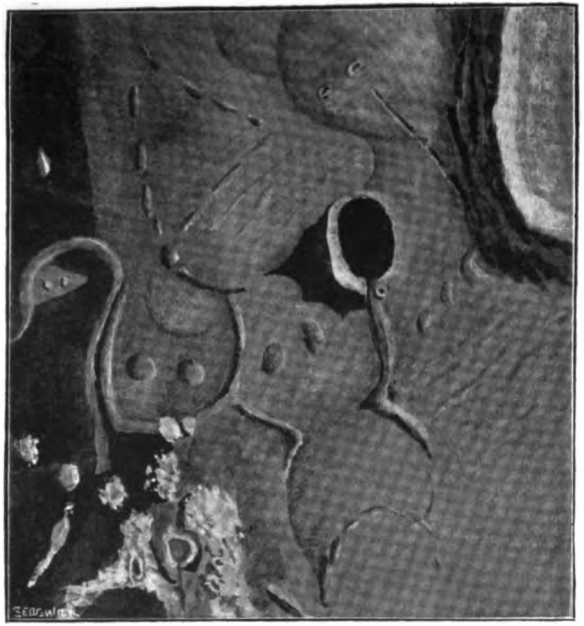

FIG. 1. MÄDLER AND THE NEIGHBOURHOOD
(1886, September 17, 10 h. to 11 h. 30 m.).
*By T. Gwyn Elger, F.R.A.S.*

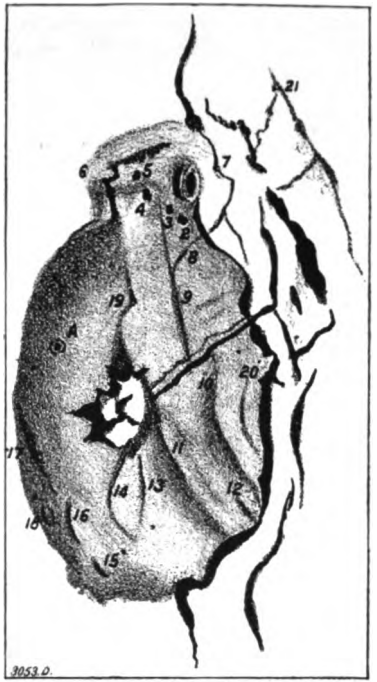


FIG. 2. PETAVIUS
(1894, November 14, 9 h. to 10 h.).
*By Dr. T. Steele Sheldon, F.R.A.S.*

PLATE III.

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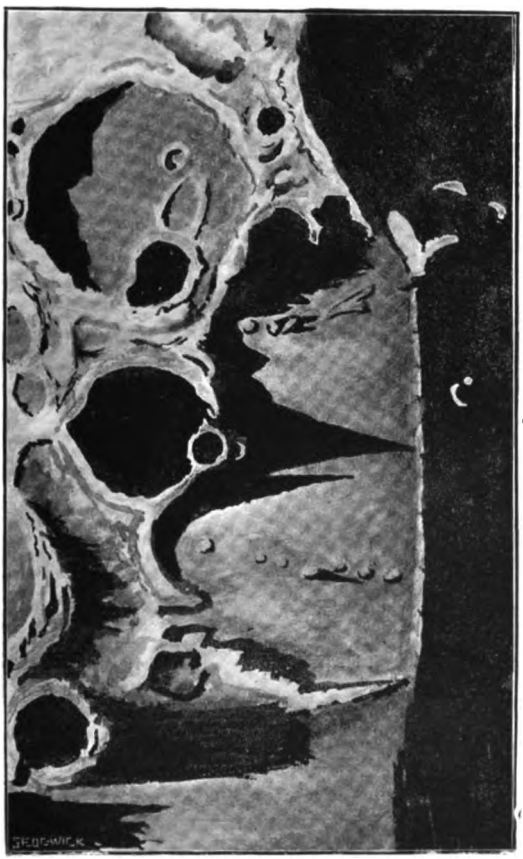

FIG. 1. THEBIT AND THE NEIGHBOURHOOD AND THE STRAIGHT WALL (1893, May 24, 9 h. 10 m.).
*By H. Corder.*

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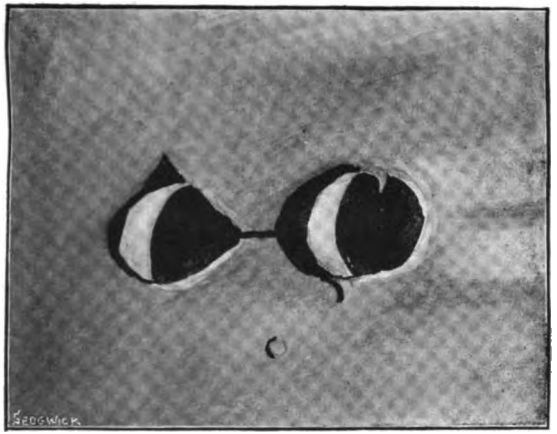

FIG. 1. MESSIER AND MESSIER A.
(1894, November 15, 11$\frac{1}{2}$h. 30 m.).
*By A. Mee, F.R.A.S.*

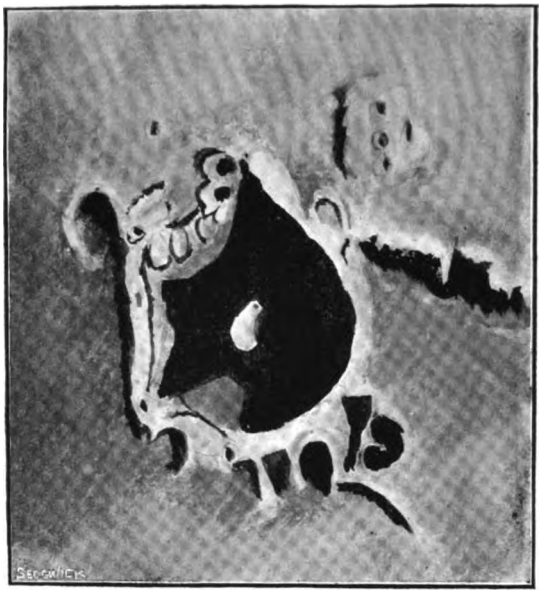

FIG. 2. PICCOLOMINI
(1893, September 3, 10 h. to 11 h.).
*By G. T. Davis.*

PLATE V.

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FIG. 1. PICCOLOMINI (SUNRISE)
(1891, December 19, 11 h.).
*By T. Gwyn Elger, F.R.A.S.*

FIG. 2. PICCOLOMINI (SUNSET)
(1892, January 4, 5 h. 15 min.).
*By T. Gwyn Elger, F.R.A.S.*

PLATE VI.

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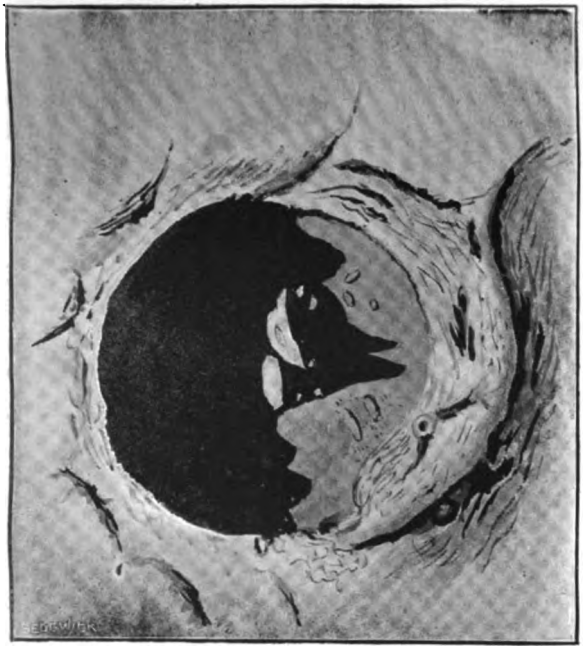

FIG. 1. THEOPHILUS
(1894, May 10, 8 h. 15 m.).
*By A. Mee, F.R.A.S.*

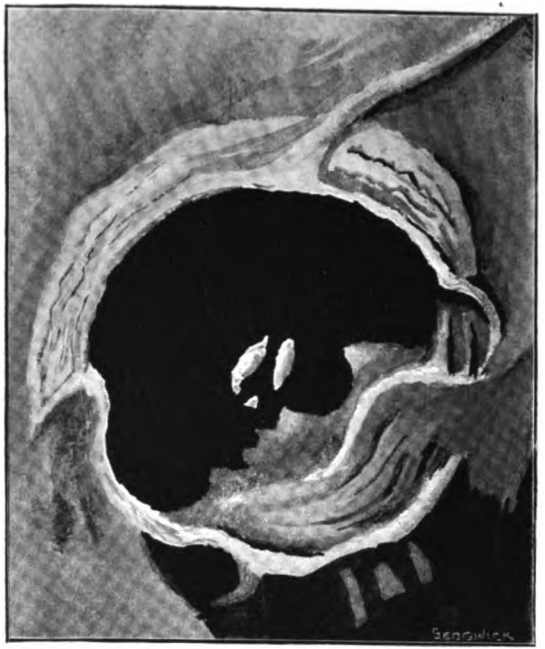

FIG. 2. THEOPHILUS
(1893, April 21, 8 h. 35 m. to 8 h. 50 m.).
*By T. Gordon, F.R.A.S.*

PLATE VII.

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# Memoirs

OF THE

# British Astronomical Association.

EDITED BY

A. S. D. RUSSELL.

REPORTS

OF THE

## OBSERVING SECTIONS.

VOL. IV.

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# INDEX.


Page

**PART I.—Third Report of the Meteoric Section** (HENRY CORDER, Director) :—

Meteor Showers, 1894 - 1
List of Meteor Radiants observed in 1894 - 8
Bright Meteors observed by Members of the British Astronomical Association - 11
Observations of Brilliant Fireballs, and doubly observed Meteors - 14
Concluding Remarks - 19

**PART II.—Fourth Report of the Jupiter Section** (REV. W. R. WAUGH, F.R.A.S., Director) :—

PART 1 - 21
PART 2 - 26
PART 3.—Satellite Observations - 33
PART 4 - 39
Distribution of Drawings - 41

**PART III.—Fourth Report of the Solar Section** (MISS E. BROWN, F.R.Met.S., Director) :—

Introduction - 43
Names of Observers - 44
Calendar of Sun-spots and Faculæ - 45
Sun-spot Ledger 1894 - 57

**PART IV.—Second Report of the Mars Section** (BERNARD E. CAMMELL, F.R.A.S., Director) :—

Introduction - 107
Members of the Section - 107
List of Drawings - 108
Syrtis Minor - 112
Solis Lacus and Neighbouring Region - 112
Syrtis Major - 113
Mare Cimmerium - 114
Satellites - 114
The Weather - 114
Colours of Mars - 115
Changes of Colour - 115
The S. Polar Cap - 116
The N. Polar Cap - 116
White Spots - 117
List of Canals and Observers - 117
Report of A. STANLEY WILLIAMS, F.R.A.S. - 119
Report of E. M. ANTONIADI - 128
Report of E. WALTER MAUNDER, F.R.A.S. - 129
General Notes by MEMBERS OF THE SECTION - 132


1 p. 5060.

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# ILLUSTRATIONS.


| | Page |
|---|---|
| Brilliant Meteor and Cosmic Cloud of August 26 | 18 |
| Diagram illustrating Jupiter's Belts | 24 |
| Occultation reappearance of Satellite III. | 36 |
| 1 Plate, 21 Drawings of Jupiter (end of Report of Jupiter Section). | |
| 8 Plates of Sun-spots (end of Report of Solar Section). | |
| Changes in the *Solis Lacus*, 1894 (Henderson) | 112 |
| Bright projection on the terminator of Mars, 1894, Aug. 18 | 119 |
| Bright projection on the terminator of Mars, 1894, Sept. 6 | 120 |
| *Syrtis Minor*, 1894, Oct. 12 | 121 |
| *Syrtis Minor*, 1894, Oct. 14 | 121 |
| *Atlantis*, 1894, Nov. 23 | 122 |
| *Hellas*, 1894, Nov. 16 | 123 |
| *Lacus Lunæ*, 1894, Nov. 5 | 124 |
| *Solis Lacus*, 1894, Sept. 23, 26, 29 | 126 |
| 4 Plates, 24 Drawings of Mars (end of Report of Mars Section). | |


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# SECTION FOR THE OBSERVATION OF METEORS.

DIRECTOR.—HENRY CORDER.

## REPORT OF THE SECTION.

### Meteor Showers, 1894.

QUADRANTIDS OF JANUARY 1–3.

This shower was not well observed, as the weather was not very favourable, and meteors seemed scarce.

At Bristol, Mr. Denning saw in all about a dozen meteors on January 1 and 2, but none of them appeared to be Quadrantids, although the watches extended over about three hours altogether.

Mr. Milligan, at Belfast, was watching for a short time on January 2, and saw two bright meteors in the northern sky, and then clouds came on.

At Bridgwater the Director was out at intervals during the night of January 1, about 3½ hours altogether, and registered 19 meteors, of which only seven were Quadrantids.

Between $6^h\ 55^m$ and $7^h\ 35^m$, January 2, the hourly number was very high for a short spurt, and several Quadrantids and Herculids were seen. After this the number dropped to four or five an hour, and rose again to eight between $11^h$ and $12^h$. The Herculids, with a radiant at $240° + 48°$, were more interesting meteors generally, having faint red streaks, and bluish heads, while the Quadrantids were rather quicker but not often leaving streaks. Their radiant appeared to be at $219° + 53°$. There was an interesting shower of slow orange meteors with a radiant about 1° above $\beta$ Tauri, and other feeble showers in Gemini, Lynx, &c.

Mr. Backhouse sends the following table, showing the results of his watch at Sunderland. He only saw one meteor as bright as Sirius.

In the table "O" means the total number of minutes of watch; "sky" the proportion of clear sky visible; "O′" the number of minutes corrected for "sky"; "Hindrance" other hindrances to visibility of meteors; "Mag. vis." the faintest stars visible; "F" the number of meteors seen in each interval of first column; and "R" the rate per hour; (·92) means seen with spectacles of that power.



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## WATCH FOR QUADRANTIDS, 1893–1894.

| Time. | O. | Sky. | O′. | Hindrance. | Mag. vis. | F. | R. |
|---|---|---|---|---|---|---|---|
| 12 mo. 30, 1893: h m h m | | | | | | | |
| 10.0 to 10.13 | 8 | ·5 | 4 | Thin cloud? and partly town light. | 6–5½ | 0 | — |
| 10.33 „ 11.18 | 16 | ·95 | 15 | Thin cloud? | 6 | 1 | 4 |
| 11.33 „ 11.48 | 7 | ·7 | 5 | „ ? | 6½ | 1 | 12 |
| 18.30 „ 18.50 | 2 | 1· | 2 | Thin cloud? and moonlight. | — | 1 | — |
| Total | 33 | — | 26 | — | — | 3 | 4·6 |
| 12 mo. 31, 1893: | | | | | | | |
| 5.50 to 9.58 | 7 | — | 4 | — | — | 0 | — |
| 1 mo. 1, 1894: | | | | | | | |
| 10.36 to 11.18 | 16 | ·65 | 10·5 | — | — | 1 | 5·7 |
| 11.25 „ 12.17 | 13 | ·6 | 8 | — | — | 1 | 7·5 |
| 15.20 „ 15.43 | 19 | ·95 | 18 | — | — | 1 | 3·3 |
| 17.14 „ 17.51 | 22 | ·9 | 19 | Slight moonlight | 6½ | 12 | 37·9 |
| 17.52 „ 18.4 | 12 | ·5 | 6 | Moonlight, and much thin cloud. | 5½–5 | 4 | 40 |
| 18.4 „ 18.32 | 15 | ·8 | 12 | Slight moonlight | 6 | 7 | 35 |
| (·92) 18.56 „ 19.11 | 11 | ·5 | 5·5 | Twilight to bright twilight. | 4½–4½ | 0 | — |
| Total | 108 | — | 79 | — | — | 26 | 19·7 |
| 1 mo. 2, 1894: | | | | | | | |
| (·92) 6.27 to 6.31 | 4 | ·5 | 2 | Auroral light and town light. | 6 | 0 | — |
| 7.3 „ 7.8 | 5 | ·5 | 2·5 | — | 6½–6 | 0 | — |
| 8.15 „ 8.20 | 4 | ·3 | 1·2 | — | — | 0 | — |
| Total | 13 | — | 6 | — | — | 0 | — |
| 1 mo. 4, 1894: | | | | | | | |
| 6.9 to 6.20 | 6 | ·6 | 4 | Partly town light | — | 0 | — |
| Grand Total | 167 | — | 119 | — | — | 29 | 14·1 |

The columns are as in previous reports.

### LYRIDS AND AQUARIDS OF APRIL—MAY.

The full moon at the time of the Lyrid shower made observations almost impossible. The evenings of April 22 and 23 were fixed upon for a combined watch, but almost nothing was seen. On the 25th six meteors were seen at Bridgwater, of which two may have been Lyrids, but no others were reported. On April 30 a watch was kept for Aquarids from $13^h\ 30^m$ till daylight, but none were seen. Mr. Milligan also watched several times in the morning hours without result, so that we may suppose that the



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Aquarids, at any rate, did not return in any strength this year, and probably the Lyrids were also but feeble.

### AQUARIDS OF JULY—AUGUST.

Of these interesting meteors eight were seen by the Director, commencing July 26, and lasting on through August. A bright meteor, on September 26, was almost certainly from this radiant, which was pretty well defined at 335° — 14°. The meteors have very long courses, are generally white, and often have a train which lengthens out into a very thin streak. At about the same time there is another shower from near $\eta$ Aquarii 338° — 3°, but the meteors are shorter and quicker, and less interesting. There is also a shower of long slow meteors from near $\alpha$ Capricorni, lasting through the same period, but only two or three were seen this year.

### PERSEIDS OF AUGUST.

In the South of England generally, the Perseid epoch was a time of very cloudy weather.

At Melplash Vicarage, Rev. S. J. Johnson reports weather singularly unfavourable. On August 8, one meteor; on August 9, watching from $10^h\ 32^m$ to $11^h\ 32^m$, only one meteor seen through breaks in the cloud. August 10 and 11, quite overcast.

At Bristol and Bridgwater similar conditions prevailed. Mr. Denning saw practically nothing, and the writer only registered 14 meteors from the whole Perseid group of radiants.

Mr. H. J. Townshend, who was staying at Paignton, Torquay, had better skies, and saw about 30 meteors, some of them very bright, which are recorded in the list of brilliant meteors. He found the Perseid radiant at 45° + 51°, and one in Camelus on August 10, at 66° + 59°.

Mr. Backhouse, at Sunderland, sends the following details of his watch, also a list of bright meteors given elsewhere, and he notes that "bright meteors seemed very numerous." (Mr. Backhouse's table follows.)

Mr. E. R. Blakeley, at Dewsbury, seems to have had the best view, and obtained observations on the 6th, 9th, and 10th, and gives the following table of radiants and also kindly furnishes a very interesting report on the details of the shower, so that we can form some idea of it, and of the large number of brilliant meteors which characterised it:—

| Date. | Radiant. | No. of Meteors. |
|---|---|---|
| August 6 - | 40° + 56° | 5 |
| „ 6 - | 39 + 51 | 8 |
| „ 9 - | 42 + 56 | 17 |
| „ 10 - | 45 + 55 | 24 |
| „ 10 - | 42 + 54 | 16 |
| „ 10 - | 40 + 59 | 9 |



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"The above table shows the position of the radiant point of the Perseids between August 6 and 10, as observed at Dewsbury. Unfortunately, just when the shower seemed to promise the most interesting results, observations were rendered impossible owing to bad weather, but enough was seen to show that the shower was of extreme interest. The writer had intended to watch for the commencement of the shower, but clouds prevented until August 6, when 17 meteors were seen in one hour, of which 13 were Perseids. Two radiants were clearly marked, that at 40° + 56° giving brighter meteors than the one at 39° + 51°, out of the five assigned to the former shower three being equal to or brighter than 1st mag.

"The rule was observed this year, as last, only to map meteors which were well observed, though all others were recorded to help the estimates for horary numbers.

"On August 9 only one radiant was apparent, and that of a rather diffuse character, though sufficiently well marked to assign its position to 42° + 56°, with from 17 to 20 meteors. Length of watch two hours.

"On the night of the maximum, August 10, the writer decided to use two maps, the first (Map A) being used from $10^h\ 40^m$ to $12^h\ 15^m$. During this period about 24 Perseids were seen, giving a good radiant at 45° + 55°. At $12^h\ 40^m$ observations were recommenced with Map B, and continued until $14^h\ 0^m$. And now it was that the interesting character of the shower became most manifest. For now two entirely fresh radiants came out: the one at 42° + 54° with about 16 meteors, and the other at 40° + 59°, with about nine meteors; the two points being quite distinct. Some signs were still apparent of the former radiant at 45° + 55°, but this was not distinctly marked. At $14^h\ 0^m$ a great bank of clouds came up and stopped all further work, nor was it fine again for a week, when the moon stopped observations of the end of the shower. I especially wish to call attention to the fact that the three radiants found on the 10th are not mere sections of a large area; each point comes out sharply, and is in no way confused with the others.

"It should be mentioned that on Map A are some indications of the radiant at 40° + 59° which came out afterwards on Map B.

"The hourly number of the Perseids will be seen from the following table:—

| Date. | Time. | Duration. | Do. discounted for Clouds, &c. | No. of Perseids. | Hourly Rate. |
|---|---|---|---|---|---|
| | h m h m | h m | h m | | |
| 6 | 12 20 to 13 25 | 1 5 | 1 0 | 13 | 13 |
| 9 | 11 30 to 13 25 | 1 55 | 1 50 | 20 | 11 |
| 10 | 10 40 to 11 40 | 1 0 | 0 52 | 23 | 27 |
| 10 | 11 40 to 12 10 | 0 30 | 0 20 | 8 | 24 |
| 10 | 12 40 to 13 40 | 1 0 | 0 55 | 32 | 35 |
| 10 | 13 40 to 14 0 | 0 20 | 0 15 | 8 | 32 |



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"The number of bright meteors was much greater this year than last. Whereas last year the number of meteors equal to or brighter than Sirius was 20 out of about 250 meteors mapped, or 1 in 12, this year 15 out of about 90, or 1 in 6, were seen."

Mr. Booth at Leeds also succeeded in observing a double Perseid radiant. It will be remembered that last year some observers recorded this occurrence, but that Mr. Denning observing at the same time did not notice it. He is still inclined to be doubtful about it, saying that it may be so, but that he himself has not observed such a thing. It is much to be hoped that accurate observation or photography will in time settle this vexed question. The similar double radiant of Lyrids, of Quadrantids with Herculids, of Castor and Pollux Geminids (which last-mentioned twin shower Mr. Denning does allow), and large areas of radiation at the time of Orionids, Taurids and other minor showers, seem to point to some breaking up of the original meteor swarm, possibly by the annual collision with the earth, and it behoves all meteor observers to collect all the material they can for the solution of the whole problem of meteoric radiation and circulation in space.

At Belfast Mr. Milligan first noticed Perseids on August 4 with a radiant at 45° + 57°, after which there seemed to be a lull in the shower, but on the 9th they were very active, and on the 10th more were seen. Other radiants seen by this and other observers at the same time as the Perseids will be given in the general list.

WATCH for METEORS during PERSEID PERIOD, 8 mo. 1894; by T. W. BACKHOUSE, at Sunderland.

| Day and Time. | Minutes of watching. | Sky. | Minutes corrected for sky. | Hindrance to Visibility. | Total Meteors seen. | Rate per Hour. | Perseids. |
|---|---|---|---|---|---|---|---|
| d h<br>5.11 | 5 | 1·0 | 5 | Slight twilight | 0 | — | 0 |
| h m h m<br>6.10.28 to 10.55 | 6 | 1·0 | 6 | Partly slight twilight | 1 | 10 | 0 |
| 12.0 „ 12.24 | 9 | 1·0 | 9 | — | 1 | 6·6 | 1? |
| 12.35 „ 12.55 | 10 | 1 | 10 | — | 0 | — | 0 |
| Total | 25 | — | 25 | — | 2 | 4·8 | — |
| 9.10.38 to 10.46 | 8 | ·8 | 6·4 | — | 1 | 10 | 1 |
| 10.51 „ 12.55 | 12 | ·8 | 9·6 | — | 3 | 18 | 2+1? |
| Total | 20 | — | 16 | — | 4 | 15·0 | — |
| 10.10.59 to 11.11 | 12 | ·9 | 10·8 | Slight moonlight | 7 | 38·2 | 7 |
| 11.17 „ 11.45 | 27 | ·93 | 25·1 | Auroral light | 19 | 45·6 | 15+1? |
| 12.18 „ 13.24 | 17 | ·63 | 10·8 | „ | 8 | 43·6 | 8 |
| Total | 56 | — | 47 | — | 34 | 43·4 | — |
| Grand Total | 106 | — | 93 | — | 40 | 25·8 | — |



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## AUTUMN METEOR SHOWERS.

Moonlight and bad weather destroyed almost every chance of further work on the showers. Several observers attempted watches for Leonids in November, but only two or three were seen, it being full moon. Still, it is pretty certain there was no important return of the shower. Mr. Backhouse sends the following table of his watch for Leonids and Taurids.

WATCH for TAURID and LEONID METEORS, 1894; by T. W. BACKHOUSE.

| Time. | O. | Sky. | O′. | Hindrance. | F. | R. |
|---|---|---|---|---|---|---|
| 11 mo. 5: | | | | | | |
| h m h m 6.51 to 7.0 | 9 | 1·0 | 9 | Moonlight | 0 | — |
| 7.28 „ 8.0 | 6 | 1·0 | 6 | „ | 0 | — |
| 9.15 „ 9.28 | 12 | 1·0 | 12 | Slight moonlight | 0 | — |
| Total | 27 | — | 27 | — | 0 | — |
| 11 mo. 6: | | | | | | |
| 11 to 14.30 | 5 | 1·0 | 5 | — | 1 | = 12·0 |
| 14.56 „ 15.8 | 6 | 1·0 | 6 | — | 0 | — |
| Total | 11 | — | 11 | — | 1 | 5·5 |
| 11 mo. 7 | 6 | ·8 | 5 | — | 0 | — |
| 11 mo. 8: | | | | | | |
| 7.25 to 9.10 | 19 | 1·0 | 19 | Moonlight | 0 | — |
| 10 „ 12.27 | 10 | 1·0 | 10 | „ | 0 | — |
| Total | 29 | — | 29 | — | 0 | — |
| 11 mo. 9: | | | | | | |
| 9.45 to 12 | 10 | ·9 | 9 | Bright moonlight | 0 | — |
| 16.50 „ 17.5 | 12 | ·9 | 11 | „ | 2 | 10·9 |
| Total | 22 | — | 20 | — | 2 | 6 |
| 11 mo. 14: | | | | | | |
| 9 to 11.30 | 5 | ·9 | 4 | Bright moonlight | 0 | — |
| 11.50 „ 12 | 6 | 1·0 | 6 | „ | 0 | — |
| Total | 11 | — | 10 | — | 0 | — |
| Grand Total | 106 | — | 102 | — | 3 | 1·7 |

THE ANDROMEDES cannot have been visible to any extent. Mr. Pope at Dingwall kept watch on the date of their return last time, November 23 and also 24, and saw nothing. At Bridgwater meteors were seen almost every night in the middle of November up to the 25th, on which night between $7^h$ and $11^h$, only one meteor from Andromeda was seen, and the general hourly number



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was only five. It was then cloudy until November 30, when in about three hours watching 13 meteors were seen, of which two may possibly have belonged to this shower.

THE TAURIDS were very scarce, only 25 being seen from Bridgwater during all the watches from the end of October into December. The usual radiant near A Tauri was scarcely marked, but there were three positions, one near the Pleiades at 55° + 27°, another near Aldebaran at 67° + 15°, and an intermediate position, probably the true Taurids at 57° + 22°, but scarcely any of the 25 were from this radiant.

THE ARIETIDS, MUSCIDS, AND CETIDS were also feebly shown. The first mentioned produced nine meteors from 47° + 19°, and 12 meteors were seen from near *o* Tauri at 50° + 6°. Last year so many bright ones were seen.

It was bright moonlight again at the time of the Geminids, December 9th to 13th, and scarcely any were seen. Mr. Milligan and others were on the look out, and the Director managed to secure seven of them with a radiant above Castor, at 111° + 36°. He also suspected the Pollux radiant to be active as early as November 5, when eight small meteors gave radiants at 118° + 29° and 122° + 26°.

GEMINID PERIOD, 1894.

| Time. | O. | Sky. | O′. | Hindrance. | Mag. vis. | F. | R. |
|---|---|---|---|---|---|---|---|
| 12 mo. 7: | | | | | | | |
| h m h m 11.12 to 11.29 | 7 | 1· | 7 | Bright moonlight | 5½ | 0 | — |
| 11.40 „ 12.0 | 3 | ·8 | 2 | „ | 5½ | 0 | — |
| 16.2 „ 16.27 | 17 | 1· | 17 | — | — | 2 | — |
| Total | 27 | — | 26 | — | — | 2 | 4·6 |
| 12 mo. 8: | | | | | | | |
| 6.40 to 7.0 | 11 | 1· | 11 | Bright moonlight and misty. | 4½ | — | — |
| 8.45 „ 9.30 — | 13 | 1· | 13 | „ | 4½ | — | — |
| 8.45 „ 9.30 (.92)* | 6 | 1· | 6 | „ | 4½ | — | — |
| 10 „ 11.5 | 5 | 1· | 5 | „ | 3–4½ | — | — |
| Total | 35 | — | 35 | — | — | 0 | 0 |
| 12 mo. 13: | | | | | | | |
| 9 to 11.59 | 26 | 1· | 26 | Bright moonlight | 4 | 0 | 0 |
| Grand Total | 88 | — | 87 | — | — | 2 | 1·4 |

The important shower of slow meteors from near β Tauri in the first week of December, was also very feeble this year, only three being seen at Bridgwater during several watches. A good deal of the evidence is therefore only negative in 1894, but may be useful at some future time in estimating the dates of maxima and minima of the showers.



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## List of Meteor Radiants observed in 1894.

The following list contains all the positions of meteor shower radiants which are of any value; but the bad weather has made it impossible to bring together a sufficient number of tracks, and many of them must be taken as very doubtful. In most cases, however, they represent showers previously observed and therefore have an interest, showing that the shower is still active.

The description of the classes will be found in last years' report. The first column is a continuation of the British Astronomical Association list of radiants and is carried on from year to year.

A number of meteor paths have been kindly sent by Prof. A. S. Herschel, many of which help up some weak position.

Observers.—B. = E. R. BLAKELEY.
C. = H. CORDER.
D. = W. F. DENNING.
H. = A. S. HERSCHEL.
M. = W. H. MILLIGAN.
T. = H. J. TOWNSHEND.
Y. = OBSERVERS AT BOOTHAM SCHOOL, YORK.

### Meteor Radiants, 1894.

| B.A.A. Ref. No. | Date. | Name. | Position. | No. of ψ's. | Class. | Observer. |
|---|---|---|---|---|---|---|
| 347 | 1894. Jan. 1–2 | Quadrantids | 219° + 53° | 14 | Slowish | C. |
| 348 | „ 1–2 | Herculids | 240 + 48 | 6 | Swift | C. |
| 349 | „ 1–2 | Herculids | 231 + 43 | 6 | Swift | C. |
| 350 | „ 1–2 | Monoceros | 124 − 5 | — | Quick | D. |
| 351 | „ 1–2 | Gemini | 107 + 25 | — | Quick | C.D. |
| 352 | Dec.–Jan. | Lynx | 137 + 38 | 9 | Quick | C. |
| 353 | Jan. 1 | δ Ursæ Maj. | 180 + 56 | 3 | Slow | C. |
| 354 | „ 1–2 | β Tauri | 85 + 28 | 4 | - | C. |
| 355 | Mar. 4 | Ursa Maj. | 136 + 58 | — | Quick | B. |
| 356 | Mar.–Apr. | Coronids | 236 + 39 | 3 | Quick | C. |
| 357 | „ | ε Bootis | 215 + 29 | 2 | Swift | C. |
| 358 | „ | α Lyræ | 279 + 40 | 3 | Slow | C. |
| 359 | April 9 | Corvus | 206 − 15 | 2 | Swift | C. |
| 360 | „ 23 | α Capricorni | 309 − 17 | 3 | Swift | H.C. |
| 361 | „ 30 | α Pegasi | 347 + 18 | 4 | - | H.C. |
| 362 | April | Pisces | 344 − 5 | — | - | H. |
| 363 | „ | Equuleus | 313 + 6 | — | - | H. |
| 364 | May | Aquarids | 325 − 3 | 2 | Swift | M. |
| 365 | July–Aug. | Aquarids | 335 − 14 | 8 | Slow | C. |
| 366 | „ | η Aquarii | 338 − 2 | 3 | Slow | B. |



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| B.A.A. Ref. No. | Date. | Name. | Position. | No. of ψ's. | Class. | Observer. |
|---|---|---|---|---|---|---|
| | 1894. | | | | | |
| 367 | July–Aug. | η Aquarii | 338° − 3° | 7 | Slow | C. |
| 368 | „ | Capricornids | 305 − 16 | 2 | Slow | C. |
| 369 | „ | Equuleus | 312 + 6 | 3 | Quick | C. |
| 370 | „ | μ Cygni | 324 + 31 | 4 | Quick | C. |
| 371 | „ | θ Lyræ | 290 + 38 | 3 | Quick | C. |
| 372 | „ | β Aurigæ | 86 + 46 | 5 | Swift | C. |
| 373 | „ | Polarids | 290 + 87 | 4 | Quick | B. |
| 374 | „ | Polarids | 300 + 88 | 4 | Quick | C. |
| 375 | „ | Cassiopeids | 20 + 66 | 5 | Swift | B. |
| 376 | „ | Cassiopeids | 15 + 64 | | | B. |
| 377 | „ | Cassiopeids | 16 + 58 | 3 | Swift | C. |
| 378 | „ | Cassiopeids | 25 + 70 | — | Swift | M. |
| 379 | „ | Andromeda | 5 + 35 | — | | M. |
| 380 | „ | Andromeda | 5 + 50 | — | | M. |
| 381 | „ | Pisces | 8 + 20 | — | Quick | M. |
| 382 | Aug. | Cygnids | 282 + 46 | 3 | Swift | B. |
| 383 | „ | γ Cephei | 350 + 75 | 3 | Quick | B. |
| 384 | „ 6 | Perseids | 45 + 57 | — | Swift | M. |
| 385 | „ 6 | Perseids | 40 + 56 | 5 | Swift | B. |
| 386 | „ 6 | Perseids | 39 + 51 | 6 | Swift | B. |
| 387 | „ 6 | Perseids | 36 + 59 | 4 | Swift | B. |
| 388 | „ 8 | Perseids | 47 + 57 | 4 | Swift | C. |
| 389 | „ 9 | Perseids | 42 + 56 | 17 | Swift | B. |
| 390 | „ 10 | Perseids | 45 + 55 | 24 | Swift | B. |
| 391 | „ 10 | Perseids | 42 + 54 | 16 | Swift | B. |
| 392 | „ 10 | Perseids | 40 + 59 | 9 | Swift | B. |
| 393 | „ 10 | Perseids | 45 + 51 | 15 | Swift | T. |
| 394 | „ 10 | Camelids | 66 + 59 | 5 | Swift | T. |
| 395 | „ 25 | Camelids | 66 + 60 | 4 | Swift | C. |
| 396 | Aug. | γ Persei | 41 + 54 | 2 | Swift | C. |
| 397 | „ | α Persei | 43 + 51 | 4 | Swift | C. |
| 398 | „ 26–29 | κ Cephei | 300 + 80 | 7 | Quick | C. |
| 399 | „ 26–29 | κ Cephei | 305 + 78 | 2 | Quick | B. |
| 400 | Aug. | θ Draconis | 248 + 55 | 3 | Quick | C. |
| 401 | Sept. | α Cygni | 315 + 46 | 4 | Quick | C. |
| 402 | „ | φ Andromedæ | 20 + 49 | 5 | Quick | C. |
| 403 | „ | ξ Draconis | 275 + 53 | 7 | Quick | C. |
| 404 | „ | | 277 + 57 | | | |
| 405 | „ | Camelus | 88 + 74 | 10 | Swift | B.C. |



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| B.A.A. Ref. No. | Date. | Name. | Position. | No. of ψ's. | Class. | Observer. |
|---|---|---|---|---|---|---|
| | 1894. | | ° ° | | | |
| 406 | Sept. | Triangulum | 30 + 15 | 4 | Quick | B. |
| 407 | Sept.-Oct. | Aquarids | 327 − 12 | 3 | Slow | C. |
| 408 | „ | ζ Cygni | 314 + 29 | 6 | Slow | C. |
| 409 | Oct.-Nov. | γ Geminids | 97 + 18 | 5 | Swift | C. |
| 410 | „ | Aurigids | 84 + 49 | 15 | Quick | C. |
| 411 | „ | Aurigids | 70 + 44 | | | |
| 412 | „ | Hydra | 135 − 5 | — | Swift | C. |
| 413 | „ | Hydra | 152 − 13 | — | Swift | C. |
| 414 | „ | Arietids | 47 + 19 | 9 | Slow | C. |
| 415 | „ | Arietids | 38 + 23 | 4 | Slow | B. |
| 416 | „ | Cetids | 50 + 6 | 12 | Slow | C. |
| 417 | „ | Taurids | 55 + 19 | — | Slow | B. |
| 418 | „ | Taurids | 57 + 22 | 10 | Slow | C. |
| 419 | „ | Pleiades | 55 + 27 | 9 | Slow | C. |
| 420 | „ | α Taurids | 67 + 15 | 6 | Slow | C. |
| 421 | Nov. 2 | Camelus | 171 + 82 | 4 | Quick | C. |
| 422 | „ 2 | σ Ursæ Maj. | 219 + 63 | 5 | Slowish | C. |
| 423 | „ 5 | Geminids | 118 + 29 | 8 | Quick | B.C. |
| 424 | „ | Geminids | 122 + 26 | | | |
| 425 | „ 5 | σ Leonis | 142 + 15 | 3 | Swift | C. |
| 426 | Nov. | Leonids | 152 + 27 | 4 | Swift | C. |
| 427 | „ | ζ Tauri | 86 + 20 | 5 | Quick | C. |
| 428 | „ | β Cephei | 325 + 70 | 3 | Slow | C. |
| 429 | „ | Draconids | 290 + 60 | 6 | Slow | C. |
| 430 | „ | Canes Venat. | 185 + 44 | 4 | Swift | C.H.Y. |
| 431 | „ | Canes Venat. | 210 + 40 | | | |
| 432 | „ | Lynx | 140 + 41 | 3 | Swift | C. |
| 433 | „ | Perseus | 39 + 57 | 3 | Quick | C. |
| 434 | „ | Monoceros | 92 − 7 | — | Swift | B. |
| 435 | „ | Canis Major | 113 − 15 | 2 | Swift | C. |
| 436 | „ | Cygnids | 314 + 51 | — | Quick | Y. |
| 437 | „ | α Hydræ | 147 − 7 | — | Swift | H.Y. |
| 438 | Nov.-Dec. | Taurids | 55 + 18 | — | Slow | B.C. |
| 439 | „ | Cetids | 29 − 8 | 4 | Slow | B.C. |
| 440 | „ | Leonids | 155 + 25 | 4 | Swift | C. |
| 441 | Dec. | θ Ursæ Maj. | 141 + 50 | 4 | Quick | C. |
| 442 | „ | Geminids | 111 + 36 | 7 | Quick | C. |
| 443 | Dec.-Jan. | Eridanids | 62 − 23 | 3 | Slow | T.D.C. |
| 444 | Dec. | Monoceros | 90 − 12 | — | Swift | T. |
| 445 | „ | Canes Venat. | 183 + 42 | — | Swift | T. |



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## BRIGHT METEORS OBSERVED BY MEMBERS OF THE BRITISH ASTRONOMICAL ASSOCIATION.

| Date. | Time. | Mag. | Remarks. |
|---|---|---|---|
| 1894. | h m | | |
| Jan. 1 - | 17 26 | Sirius | Yellow, directed from about ½ (ι, γ) Cancri, passed ½ (β, α) Canis Min., and went 6° further. Slowish.—T. W. BACKHOUSE. |
| „ 25 - | 10 1 | ½ | Green, directed from about Jupiter, disappeared behind house at 75½ − 25°. Very slow, behind cloud, may have been brighter.—T. W. B. |
| „ 25 - | 10 1 | ☾ | From 242° + 59° to 229° + 53°, but not seen at commencement. Very brilliant, burst into two fragments (*see* special note).—W. F. DENNING. |
| Feb. 9 - | 12 32 | >♀ | Daylight meteor, metallic green, turning blue green. Visible 1½ secs. (*see* special note).—J. WYKES. |
| „ 21 - | 7 18 | ½ | From 253° + 54° to 253½° + 49°, low in the north.—W. F. D. |
| „ 26 - | 8 0½ | > 1 | About 2° below ν' Hydræ, falling perpendicularly.—REV. S. J. JOHNSON. |
| Apr. 22 - | 7 35 | ☾ | Green, red sparks ½ (α, β) Leonis down between Corvus and Crater (*see* special note).—F. J. WARDALE. |
| „ 25 - | 10 14 | >1 | From 218° − 11½° to 222° − 8°. Green, slow, train of sparks; a small fireball. Radiant 205° − 15°?—H. CORDER. |
| „ 25 - | 11 17 | 1 | From 157½° + 10° to 150° ± 0°. Long train of brilliant sparks.—REV. R. BRAMISH SAUL. |
| „ 29 - | 14 8 | >♀ | From 248° − 20° to 249° − 25°. Duration 3 secs. Probably near radiant 248° − 20° as almost stationary.—W. H. MILLIGAN. |
| May 1 - | 10 25 | >1 | From near θ Lyræ towards N.W. horison. Yellowish slight trail.—G. T. DAVIS. |
| „ 12 - | 12 3 | >1 | Passed 2° below η Aquilæ, vanished ½° below ν Ophiuchi.—REV. S. J. J. |
| „ 26 - | 11 55 | ½ | From 270° − 16° to 281° − 17°. Emerald green. No train. 9½ m. later a faint but distinct detonation.—D. E. PACKER. |
| June 28 - | 12 46 | 1½ | From near δ Lyræ below θ Cygni almost to α Cephei. Red.—REV. S. J. J. |
| „ 30 - | 12 19½ | 1½ | From 1° S. of α Andromedæ. Vanishing in centre of square of Pegasus. Red. Duration, 3 secs.—REV. S. J. J. |
| July 5 - | 12 0 | >1 | From ν to γ Bootis.—REV. S. J. J. |
| „ 12 - | 10 6 | >1 | From 211° + 65° to 359° + 78°. Steel blue. Swift. No train.—H. J. TOWNSHEND. |
| „ 13 - | 10 40 | ½ | From 165° + 85° to 183° + 30°. Brilliant blue and red, burst below Cor Caroli, 3 secs.—H. J. T. |
| „ 26 - | 10 58 | >1 | From 295° − 1° to 302° − 5°. Slow, orange, with train and streak.—H. C. |
| „ 26 - | 11 43 | >1 | From 319° − 4° to 298° − 15°. Slow, white. Faint streak. Aquarid.—H. C. |
| „ 27 - | 9 38 | >1 | From near α Cygni to Mizar.—G. T. D. |
| „ 27 - | 10 3 | >1 | From ε Delphini to η Aquilæ. Streak.—G. T. D. |



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| Date. | Time. | Mag. | Remarks. |
|---|---|---|---|
| 1894. | h m | | |
| July 27 - | 11 55 | Sirius | From 326° + 37° to 326° + 25°. Greenish. Quick.—H. C. |
| „ 30 - | 11 8½ | 1½ | Passed between 70 Ophiuchi and η Serpentis. Vanishing 5° W. of ν Ophiuchi. Flashing.—REV. S. J. J. |
| Aug. 6 - | 12 21 | Sirius | Directed from 41 Arietis, dis. ½ (o Piscium, δ Ceti). Course 6°. Burst out brightly, and became green near dis. faint streak. ? Perseid.—T. W. B. |
| „ 6 - | 13 15 | ½ | From 327°+29° to 551°+3°. Slow, with flash. Cygnid.—E. R. BLAKELEY. |
| „ 8 - | 11 10 | 1 | Passed 10° W. of ι Pegasi to ζ Aquarii. Reddish.—REV. S. J. J. |
| „ 9 - | 10 14 | >1 | From 33° +54° to 359° +75°. 2 secs. Swift, short, with bent course. Very brilliant, bursting out red and blue.—H. J. T. |
| „ 9 - | 10 44 | ½ | Directed from about ½ (δ Persei, Cap.) dis. ½ (α, β) Cephei. Course 12°. Orange, beautiful. Bright streak left, 2 secs. Perseid.—T. W. B. |
| „ 9 - | 12 16 | Sirius | From 42½°+27° to 44°+12°. Swift. Streak. Perseid.—E. R. B. |
| „ 9 - | 12 44 | ½ | From 31° + 16° to 27° − 4°. Swift, streak. Perseid.—E. R. B. |
| „ 9 - | 13 16 | 4th | Commenced at 340°+68°; when near α Cygni it turned at an angle, passing from 304° + 46° to 286° + 38°. Very swift.—E. R. B. |
| „ 10 - | 10 0 | >1 | From 2° + 59° to 282° + 43°. Brilliant blue and red. 3 secs. Burst at Vega. Streak.—H. J. T. |
| „ 10 - | 10 3 | Sirius | From 60° + 51° to 98° + 47°. Brilliant blue. 2 secs.—H. J. T. |
| „ 10 - | 11 1 | Vega | Directed from γ Cephei, passed exactly ½ (α Cephei, δ Draconis). Deep yellow, left bright streak for 2 secs. Perseid.—T. W. B. |
| „ 10 - | 11 9 | ½ | Disappearance about 2° from β Ceti towards γ Cancri. Perseid.—T. W. B. |
| „ 10 - | 11 12 | ½ | From 95°+77° to 170°+69½°. Swift. Streak. Perseid.—E. R. B. |
| „ 10 - | 11 28 | Sirius | Near π Capricorni? Perseid.—T. W. B. |
| „ 10 - | 11 30½ | Sirius | From 75° + 51½ to 94° + 45½°. Very swift. Streak Perseid.—E. R. B. |
| „ 10 - | 11 35 | 1−½ | From 43°+30° to 43°+15°. Flashed out at end. Swift streak. Perseid.—E. R. B. |
| „ 10 - | 11 35 | Sirius | Directed from ν Andromedæ, passed near 51 Piscium. Left streak for 3 secs. Perseid.—T. W. B. |
| „ 10 - | 11 37½ | Sirius | From 58°+40° to 65°+30°. Swift. Streak. Perseid.—E. R. B. |
| „ 10 - | 11 39 | ½ | Passed γ Trianguli, passing β Arietis. Very beautiful. Left bright streak. 3 secs. Perseid.—T. W. B. |
| „ 10 - | 12 5 | ½ | From 90°+64° to 125°+58½°. Swift. Streak. Perseid.—E. R. B. |
| „ 10 - | 12 10 | Sirius | From 10°+14° to 360°−8°. Swift. Streak. Perseid.—E. R. B. |



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| Date. | Time. | Mag. | Remarks. |
|---|---|---|---|
| 1894. | h m | | |
| Aug. 10 - | 12 22 | Sirius | Directed from 1½° above α Trianguli, passed ½ above ξ Piscium. Orange. Left bright streak, faintly for 4 secs. Perseid.—T. W. B. |
| „ 10 - | 12 49 | Sirius | From 75°+75° to 155°+73°. Swift. Streak. Perseid.—E. R. B. |
| „ 10 - | 12 59½ | Sirius | Passed ι Pegasi and 1° S. f. δ Equulei. Left streak for 3 secs. Perseid.—T. W. B. |
| „ 10 - | 13 8 | ¼ | From 34°+24° to 31°−1°. Swift. Streak. Perseid.—E. R. B. |
| „ 10 - | 13 18 | ¼ | From 43½°+32° to 43½°+10°. Swift. Streak. Perseid.—E. R. B. |
| „ 10 - | 13 20 | ¼ | From 335°+71½° to 273°+50°. Swift. Streak. Perseid.—E. R. B. |
| „ 10 - | 13 21½ | ¼ | From 78°+50° to 96°+43°. Swift. Streak. Perseid.—E. R. B. |
| „ 10 - | 13 25½ | Sirius | From 339°+25° to 357°+18°. Streak. Cygnid.—E. R. B. |
| „ 10 - | 13 40 | ♀ | From 87°+59½° to 112°+55°. Swift. Streak. Bright yellow. Flash behind cloud. Perseid.—E. R. B. |
| „ 10 - | 13 45 | Sirius | From 28½°+11° to 27°+2°. Swift. Streak. Flash. Perseid.—E. R. B. |
| „ 20 - | 8 35½ | ½☾ | From nearly midway between ζ Aquilæ and α Ophiuchi. Vanishing about 4° E. of 70 Ophiuchi. Fireball.—REV. S. J. J. |
| „ 26 - | 10 20 | >♀ | Brilliant flash. Meteor not seen, but streak left about 138°+62° to 137½°+58½° (*see* special note).—H. C. |
| „ 26 - | 10 44 | ♂ | From 352°+38° to 364°+37°. Slow. Orange red, dying out as a spark.—H. C. |
| Sept. 6 - | 9 21 | >1 | About 4° above α Arietis. Shot horizontally towards S. for a few degrees.—REV. S. J. J. |
| „ 8 - | 11 3 | ½☾ | From 337°−4° to 348°−24°. Probably same as next (*see* special note).—H. J. T., Leeds. |
| „ 8 - | 11 10 | ♀ | From 142°+54°. Disappeared behind house at 144°+51°. Slow. Green fireball, with spark train.—H. C. |
| „ 26 - | 8 3 | >1 | From 240°+39° to 195°+37½°. Slow. Orange. Train and sparks. Aquarid. Radiant 327°−12°?—H. C. |
| „ 26 - | 10 53 | ¼ | From direction of α Persei to just past κ Lyræ, leaving a conspicuous streak 30° in length, lasting 6 secs.—G. T. D. |
| „ 27 - | 11 0 | ¼ | From 65°+25° to 75°+50°. Slow. Streak.—E. R. B. |
| Oct. 29 - | 7 21½ | 1 | From 68 Herculis to 2° past 98 Herculis.—REV. S. J. J. |
| Nov. 2 - | 14 20 | Sirius | Very slow. Spark train. 5 secs.—E. R. B. |
| „ 2 - | 15 1 | ¼ | Very slow. Train.—E. R. B. |
| „ 3 - | 13 13 | >1 | Quick. Green. Streak. ? Ursid.—H. C. |
| „ 5 - | 9 29 | >♀ | From 5h. 0m. + 13½° to 6h. 10m. + 10°. Slow. Straw colour to steel blue, with red sparks. Slight train.—F. J. WARDALE. |
| „ 5 - | 10 27 | ¼ | Swift.—E. R. B. |
| „ 6 - | 8 59 | 2×¼ | Slow. sss Blue, feathery train.—J. O. HURST, per E. R. B. |



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| Date. | Time. | Mag. | Remarks. |
|---|---|---|---|
| 1894. | h m | | |
| Nov. 17 - | 7 46 | >1 | From 314° ± 0° to 306° − 8°. Imperfectly observed.—W. F. D. |
| „ 17 - | 7 46 | 0 | From 342° + 20° to 301° + 14°. Slow. Orange. Train. Radiant probably 54° + 27° near Pleiades. Same as above.—H. C. |
| Dec. 22 - | 8 12 | 0 | Slow. Orange. Train. Low down in Pisces. Directed from 1° N. of β Tauri.—H. C. |
| „ 27 - | 8 35 | 0 | Slow. Orange. From near ε Geminorum to α Orionis. —REV. R. B. SAUL. |
| „ 27 - | 10 55 | 0 | Slow. Taurid in Monoceros.—D. BOOTH, Leeds. |

Observers.—T. W. BACKHOUSE, Sunderland.
E. R. BLAKELEY, Dewsbury.
H. CORDER, Bridgwater.
G. T. DAVIS, Reading.
W. F. DENNING, Bristol.
REV. S. J. JOHNSON, Melplash Vicarage, Bridport.
W. H. MILLIGAN, Belfast.
D. E. PACKER, King's Heath, Birmingham.
REV. R. BEAMISH SAUL, Weston.
H. J. TOWNSHEND, Paignton (July, August), then Leeds.
F. J. WARDALE, Knebworth, Herts.
J. WYKES, Birmingham.

## Observations of Brilliant Fireballs, and doubly observed Meteors.

Our members have had the good fortune to see something of most of the great and remarkable meteors of 1894, and although Mr. Denning and others have already collected and discussed their observations, yet this report would lose its most interesting feature if these meteors were only relegated to the general list.

### METEORS OF JANUARY 1.

On the evening of January 1, 1894, at about 10.9, a meteor was seen by Mr. Denning, and by H. Corder, of about the 1st mag., or 2nd mag. as seen from Bridgwater, which appeared at a height of 50$^m$, a little N. of Amesbury (Wilts), and disappeared at a height of 34$^m$, rather W. of Devizes, having traversed a path of 20$^m$ in the direction of Pilning, Glos., where it would have fallen if it had not been dissipated in the air. Its radiant was in Gemini (107° + 25°, Az. 303°, Alt. 53°).

The next meteor is of the second magnitude only, on January 1, 1894, at 10.43, and was seen by Mr. Denning from Bristol, and by Prof. A. S. Herschel from Slough. It appears from Mr. Denning's observations to have been a Virginid (Radt. 185° + 15°, Az. 250° W. of S. Alt. 3°), and appeared first at a height of



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80 miles over Rickmansworth, and disappeared at a height of 77 miles over a point 7$^{m}$ S.S.W. of Hungerford, having traversed a path of 52 miles.

METEOR OF JANUARY 2.

On January 2, at 9.40, a meteor, appearing of the 3rd mag. to Prof. Herschel, and of the 2nd mag. to H. Corder, fell from a height of 65 miles over Cirencester to 55 miles over Cranborne, a path of 53 miles. This meteor had a long streak, and though not a true Quadrantid, yet it emanated from the part of Hercules nearest to Quadrans, the radiant being at 240° + 48°, from which several others were seen on that and the previous evening. (Az. 184°, Alt. 10°).

GREAT DETONATING FIREBALL OF JANUARY 25.

Mr. Denning has already published a most interesting account of this meteor ("Monthly Notices," Vol. LIV., No. 5), and it will only be necessary to notice briefly the observations of our members. The phenomenon occurred at 10.1, the sky generally being in a bad condition, only the brighter stars being visible.

At Bristol, Mr. Denning states, that although he was passing a street lamp at the time the brilliance of the meteor startled him, and looking up he saw a double-headed fireball just before its disappearance. The observed path was from 242° + 59° to 229° + 53°, but was not nearly the whole of the real path. Near the end of its course the fireballs subdivided and became a string of particles. No sound of the explosion was heard. From Sunderland through the clouds the meteor appeared to Mr. Backhouse of a green colour, and about as bright as Jupiter. Its progress was very slow, and it disappeared behind a house.

Mr. D. E. Packer had a fine view of it from King's Heath, where it left a train of great length in its wake. It traversed an arc of 120° passing between Jupiter and the Pleiades, and breaking up near Rigel, after lasting about 12 seconds. The meteor sent out a distinct hissing sound during part of its passage, and three minutes after bursting the boom of its explosion was heard. The report was a double one, and was followed by a dull reverberation from all parts of the sky.

Mr. Denning calculates the true path of the meteor to have been from a height of 89 miles over a point in lat. 53° 42′ N., long. 4° 7′ W. (24 miles N.N.E. of Amlwch, Anglesey), and after traversing 160 miles, at the rate of 18 miles per second, it disappeared over Ashchurch, Tewkesbury, at a height of only 16 miles, and from the whirring sounds heard, it is possible that fragments may have fallen, the earthpoint being at Lechlade in Gloucestershire. The radiant point is at 331° + 55° near $\epsilon$ Cephei. It will be within the memory of all how tremendous was the sound of the explosions at places as near as Worcester, Malvern, and Droitwich, where much alarm was felt, at the loud detonations and shaking of buildings; and the brilliancy was greater than that of the full moon, showing how rapidly both sound and light fell off at places not more distant than Bristol or Sunderland. According to some accounts one or more brilliant meteors were seen on the same evening besides the great fireball.



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GREAT FIREBALL OF FEBRUARY 8.

The next important meteor is the great daylight fireball, of February 8, an account of which has been published by Prof. A. A. Rambaut in the proceedings of the Royal Dublin Society (Vol. VIII., Part III., No. 29).

Not many others of our members had the fortune to see this fine sight, but Mr. J. Wykes, of Bournbrook, Birmingham, writes, "I saw yesterday (February 8), a most brilliant meteor in bright "sunshine. The colour was a bright metallic green, more intense "at the head, and gradually toning down to a blue green. It "came from a S.E. direction, and was visible for about 1½ seconds. "Time 12.32." An outline sketch accompanies the letter, showing the meteor to have been of a wedge or pear-shape. Notices from non-members have also come in, one sent by Mr. Longstaffe is a description of the meteor as seen from Wimbledon Common by Miss K. Gertrude Tee, who says that in a cloudless sky, the meteor appeared with a "bright white light, "like the sun shining on a steel bar. It was visible for a few "seconds, and then sank in the north."

Mr. R. W. Christy also wrote to the Director from Roxwell, near Chelmsford, stating that he had seen it there. From Prof. Rambaut's calculations, it would seem that the meteor appeared over the estuary of the Ribble, at the height of nearly 60 miles, and after travelling across Lancashire and part of Yorkshire at a speed of 19 miles per second, it finally disappeared at a height of 14 miles over a spot about three-fifths of the distance from Sheffield towards Wakefield; but from a number of observations the path would seem to have been decidedly curved, and therefore no radiant point could be determined.

FIREBALL OF APRIL 22.

Mr. F. J. Wardale, writing from Knebworth, Herts, says:— "Yestereve (22nd), at 7.35 p.m., as near as possible, I observed "a fine fireball in the S.E. Owing to the brightness of the "twilight, few stars were visible, and an absolutely accurate path I "cannot give, but by watching till more stars appeared, the "meteor may be said to have started about half way between "$\alpha$ and $\beta$ Leonis, and moved down in a slightly curved path till "between Corvus and Crater. Its colour was a vivid green, with "a trail of red sparks, and these became larger and more "numerous near the end of its course, and it finally broke up "into a ruddy cluster, the motion of which could be traced for "2° or 3° beyond. Duration about four or five seconds. The "brightness is difficult to estimate, the full moon similarly "situated would perhaps have been rather brighter. Its diameter "appeared about 6′ of arc."

Mr. R. W. Christy also saw it from near Chelmsford, giving the time as 7.40, and says it was "much brighter than any planet, "and in view two or three seconds. Its course was from close "to $\alpha$ Leonis to a little short of Corvus, which had only just "become visible. It was a whitish light and left a brilliant "track behind it." Mr. Denning finds that the meteor descended from a height of about 80 miles above the neighbourhood of



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Hastings, and crossing over the Straits of Dover, with a real path of about 120 miles, which it traversed in about four seconds; it disappeared over Amiens at a height of 17 miles. Radiant in Perseus.

DETONATING METEOR OF MAY 26.

Mr. D. E. Packer writes from Birmingham, "At 11.55 p.m. a "magnificent fireball, of a most beautiful emerald green, passed "slowly in a horizontal direction (describing a slight curve in its "passage) from 270°—16° to 281°—17° in Sagittarius. Duration "3 seconds. No trail. About 9½ minutes after a faint but "distinct detonation was observed from that direction. Mag.= "Jupiter."

PERSEID METEOR OF AUGUST 10.

A large number of brilliant Perseids were seen from the few places where the sky was clear, but only the following one has had its real path worked out by Mr. Denning, as in general the meteors were only single observations. Some of these are noticed in the account of the shower. Mr. T. W. Backhouse registered a meteor equal in brightness to Sirius as seen from Sunderland at 11.35, and Mr. E. R. Blakeley appears to have seen the same object from Dewsbury, estimating the brightness as equal to Jupiter. Mr. Denning finds the radiant in Perseus to have been at 43°+58° in az. 226° W. of S., alt. 43°. The meteor commenced 52 miles over North Sea, lat. 54° 16′ N., long. 0° 55′ E., and ended 16 miles high over North Sea, 14 miles E.S.E. of Hornsea, lat. 53° 55′ N., long. 0° 10′ E. The earth point was on the River Humber, 3 miles S.E. of Burstwick, Yorks. The real length of path was 54 miles.

BRILLIANT METEOR AND COSMIC CLOUD OF AUGUST 26.

This remarkable object was well seen, at any rate in its later stages, over a great part of central England, and deserves special notice for its lasting streak. The meteor which caused it was a Cepheid, its radiant point being at 305+79 near κ Cephei, and, as was found last year, meteors both from this constellation and the accompanying Cygnids had a manner of flashing out suddenly near the end of their course, leaving a short persistent streak. At Bridgwater, the writer was watching the southern sky, and his attention was called at $10^h\ 20^m$ to a brilliant flash on the houses and sky, and turning round, saw the short straight streak lying vertically in the fore part of Ursa Major at from 138°+62° to 137½°+58½°. As seen with a binocular it was of a pearly-green colour, and at once began to curve in the middle into a sickle shape, and to become knotted into cloudlets. It next became Z-shaped, and the extremities dying out, the bright centre lengthened into a club-shaped cloud, and drifted away upwards, becoming gradually fainter until it was finally lost sight of with the naked eye at 10.50, half-an-hour from its formation, at a position of 98°+64°. It was lost in the binocular some time before this from want of contrast. The most interesting account which has been sent in is that by Mr. D. E. Packer, who observed the phenomenon from King's Heath, near Birmingham, and whose story of the changes

1 p. 4195.



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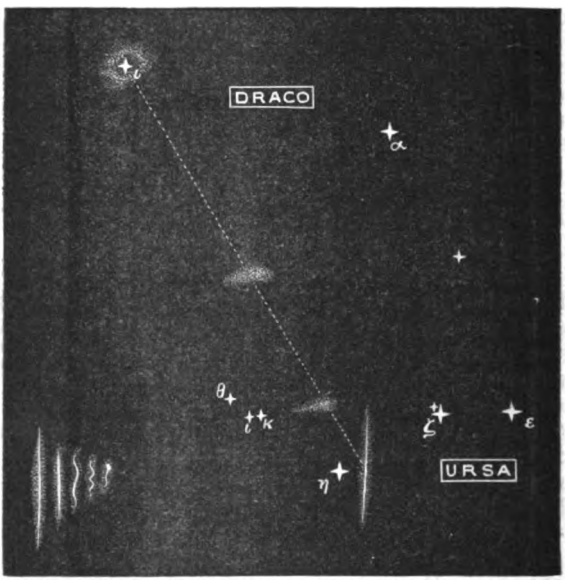
in the streak must be quoted almost *in extenso*. The instrument employed was a telescopic camera of 4-in. aperture and 2 ft. focal length, but as Mr. Packer had only just focussed his instrument, he unfortunately had no photographic plates at hand, and he says, "I had to content myself with an eye observation with a single "lens giving a power of about 20. I was agreeably surprised "to perceive a serpentine array of luminous circular plates, "slightly overlapping each other and showing distinctly various "iridescent hues, resembling mother-of-pearl. This beautiful "appearance was very transient, the respective portions gradually "merging into each other, but still retaining a hard outline for "several minutes. I kept the object steadily in view, and noted "its relative positions from its starting point near $\eta$ Ursæ, to the "point of drift $\iota$ Draconis. In 9 minutes it had drifted exactly "midway from its two extreme points, and in 17 minutes it "formed a halo round $\iota$ Draconis, the star being as nearly central "in the cloud as it was possible to determine. I noted particularly "that the cloud in its passage did not obstruct the light of "telescopic stars beyond what its inherent luminosity would have "alone effected. The cloud was seen for 20 minutes, when a "haze crept up and obscured the sky. Its diameter when "covering $\iota$ Draconis was fully 2°."




A number of other accounts were collected by Mr. Denning, who calculated the height at beginning as 90 miles over the Mersey, and at ending 30 miles over a point 3 miles E. of Ruthin, Denbighshire. The earth point at 6 miles S. of Llangollen, and real length of path 66 miles. The streak was 8 miles in length, and moved along horizontally at a height of 54 miles from 6 miles N.E. of Denbigh to 6 miles W. of Wolverhampton at a rate of 122 miles an hour. From Mr. Packer's estimate of the apparent



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size of the streak at $10^h\ 37^m$ it must have been about 4 miles in diameter.

Many observers noticed that the streak lasted some three or four minutes, but very few seem to have watched it longer or noticed the drift. Observers at Sidcot School, Weston-super-Mare, note that it lit up the landscape, and Mr. Burcham of Cirencester (per Miss E. Brown) seems to have been one of the few who saw the meteor, and speaks of it as slightly violet and three to four times as bright as a first mag. star.

GREEN FIREBALL OF SEPTEMBER 8.

At Bridgwater on this date, a few minutes past $11^h$, a fine emerald green fireball was seen to fall near $\theta$ Ursæ Majoris in the northern sky, and to disappear behind a roof, the observed path being from $140°+54°$ to $144°+151°$. It had a short train of red sparks and moved slowly. At $11^h\ 3^m$ Mr. H. J. Townshend, at Leeds, saw what was almost certainly the same body falling in the S. in Aquarius from $337°-4°$ to $348°-24°$. As the sky was hazy this path may be somewhat in error, and as at Bridgwater, the meteor soon disappeared behind a house, the observation there may not be trustworthy, and as the lines of flight were almost in exactly opposite directions no certain radiant can be determined. Mr. Townshend says that the duration was 7 seconds, and that the longest diameter of the brighter part and nucleus was not less than 30′, and while falling it expanded, and, as it were, threw off incandescent globular portions from its upper surface.

DAYLIGHT METEOR OF DECEMBER 4.

Mr. J. E. Clark sends a note of a bright daylight meteor seen at $19^h\ 20^m$, December 3, by Mr. S. N. Baker, at Sibford Ferris, near Banbury, who states that he was facing almost exactly N., and saw a brilliant meteor of a silvery blue colour issuing from a clear space in the sky at an altitude of about 45°, and falling perpendicularly to within 15° of the horizon. The duration was about 3 seconds, and it left a long streak for a short time. The speed was slow at first, but quicker towards the end of its course.

In concluding this portion of the Report, the Director wishes to acknowledge the courtesy of Mr. Denning in allowing him to make use of the interesting calculations of the heights and real paths of the meteors here set forth.

## Concluding Remarks.

The Meteoric Section during the past 12 months has consisted of almost the same Members as were given in the list in the last Report, but recently Mr. D. Booth has resigned his membership, and we regret the loss by death of Mr. F. H. Ferrington. Mr. H. J. Townshend, of Leeds, has joined the Section, and a few others have kindly sent in their observations, and the Director will take this opportunity of thanking all who have assisted him in the past, and asking the help of others interested in the work, and also for any chance observations of fire-balls or other meteors made by those who are not members of the Section, but which



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may often help in working out the real path or the radiant of a meteor.

The year 1894 has been remarkable for some very fine fireballs, some of them even visible in broad daylight, and now that so much interest is taken in astronomy a good many useful observations have been collected of most of them.

In the observation of periodic meteor showers, however, we have been very unfortunate. Some have almost failed to put in any appearance whatever, and others have been almost entirely obscured by clouds or moonlight to a quite unusual extent, so that the list of reliable radiants is a small one.

Several Members of the Section are determined to do their best during the coming season, and it is hoped that the weather will be more propitious, and that every month preconcerted watches may be kept, not only for the chief showers, but for stray shooting stars on other nights.

HENRY CORDER,
Director of the Section.



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# SECTION FOR THE OBSERVATION

OF

# JUPITER.

DIRECTOR.—REV. W. R. WAUGH, F.R.A.S.

## *FOURTH REPORT OF THE SECTION.*

### REPORT FOR THE APPARITION OF 1894 AND 1895.

## PART 1.

The following Table gives the names of the registered Members of the Section; the localities of observation; the number of drawings forwarded to the Director; the inclusive dates of the drawings; and the instruments used.

TABLE I.

| Names. | Locality. | No. of Drawings. | Instrument. | Inclusive Dates. |
|---|---|---|---|---|
| E. M. ANTONIADI | Paris | 5 | 4½-in., 9½-in. O.G. | Aug. 31, 1894; Oct. 28, 1894. |
| Rev. J. BAIKIE | Ancrum | — | — | — |
| L. BRENNER | Lussinpiccolo | 29 | 7-in. O.G. | Sept. 21, 1894; Feb. 23, 1895. |
| G. L. BROWN | Stirling | — | — | — |
| L. J. BROWN | London | — | — | — |
| R. W. BUTTEMER | Godalming | — | — | — |
| B. E. CAMMELL, F.R.A.S. | Wokingham | 2 | 12½-in. spec. | — |
| E. J. COPE | West Malvern | 3 | 8½-in. spec. | Nov. 21, 1894; Nov. 30, 1894. |
| H. CORDER | Bridgewater | 18 | 6½-in. spec. | Oct. 24, 1894; Mar. 28, 1895. |
| A. COTTAM, F.R.A.S. | Watford | — | — | — |
| Rev. Dr. CRAIG, F.R.A.S. | Londonderry | — | — | — |



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| Names. | Locality. | No. of Drawings. | Instrument. | Inclusive Dates. |
|---|---|---|---|---|
| R. CROSS | Oxford | — | — | — |
| G. T. DAVIS | Reading | 8 | 3½-in. O.G. | Nov. 19, 1894; Mar. 22, 1895. |
| H. ELLIS | Potter's Bar | 7 | 6-in. O.G. | Dec. 19, 1894; Jan. 23, 1895. |
| E. ESSAM | Billingborough | 8 | 8½-in. spec. | Nov. 15, 1984; Feb. 17, 1895. |
| J. EVERSHED, F.R.A.S. | Kenley | — | — | — |
| Rev. T. H. FOULKES, M.A. | Devonport | 21 | 10½-in. spec. | Dec. 16, 1894; Apr. 1, 1895. |
| A. FREEMAN | Hastings | — | — | — |
| W. GOODACRE, F.R.A.S. | Crouch End | 7 | 12½-in. spec. | Jan. 26, 1895; Mar. 1, 1895. |
| G. P. B. HALLOWES, F.R.A.S. | Brough | 1 | 8½-in. spec. | April 14, 1895. |
| A. HENDERSON | Liverpool | 18 | 10½-in. spec. | Sept. 8, 1894; May 10, 1895. |
| E. R. HICKS | Kensington | — | — | — |
| Rev. R. S. HUTCHINGS, F.R.A.S. | Alderbury | — | — | — |
| W. H. IZZARD | Brentford | — | — | — |
| J. JACKSON | Blackpool | — | — | — |
| W. E. JACKSON, F.R.A.S. | Constantinople | — | — | — |
| Rev. S. J. JOHNSON, F.R.A.S. | Melplash | — | — | — |
| Rev. P. H. KEMPTHORNE, F.R.A.S. | Wellington College. | 2 | 10½-in. spec. | Jan. 21, 1895; Jan. 25, 1895. |
| H. MACEWEN, F.R.A.S. | Glasgow | 2 | 5-in. O.G. | Sept. 13, 1894; Apr. 14, 1895. |
| Dr. MAINS | Portland | — | — | — |
| W. H. MAW, F.R.A.S. | Kensington | 3 | 6-in. O.G. | Dec. 12, 1894; Dec. 19, 1894. |
| J. W. MEARES, F.R.A.S. | Brighton | 6 | 3-in. O.G. | Sept.—, 1894; Feb. 25, 1894. |
| A. MEE, F.R.A.S. | Cardiff | 15 | 8½-in. spec. | Nov. 18, 1894; Mar. 31, 1894. |
| Lieut. P. B. MOLESWORTH | Hong Kong | 8 | 9½-in. spec. | Jan. 6, 1894; Jan. 29, 1894. |
| J. M. OFFORD, F.R.Met.S. | Ealing | 2 | 12½-in. spec. | Apr. 1, 1895; Apr. 9, 1895. |
| Dr. G. PATTERSON | Ascot | 32 | 11-in. spec. | Nov. 11, 1894; Apr. 1, 1895. |
| J. PHILLIPS | Hereford | 4 | 15½-in. spec. | Jan. 5, 1895; Feb. 16, 1895. |
| Rev. V. REID | Glasgow | — | — | — |
| C. ROBERTS, F.R.A.S. | Bournemouth | 72 | 6½-in. spec. | Aug. 25, 1894; May 10, 1895. |
| Dr. R. J. RYLE, M.A. | Hadley | — | — | — |
| Rev. B. SAUL | Weston-super-Mare. | 4 | 10-in. spec. | — |
| W. C. STEWART | York | 1 | — | Sept. 11, 1894. |
| Dr. SMART, F.R.A.S. | Bermondsey | 1 | 10½-in. spec. | Jan. 18, 1895. |
| C. A. TAYLOR | Kensington | 4 | 2½-in. spec. | — |
| Rev. J. H. TUCKFIELD | Tasmania | — | — | — |
| Rev. W. R. WAUGH, F.R.A.S. | Portland | 28 | 4½-in. O.G., 12-in. spec. | Oct. 8, 1894; Mar. 28, 1895. |
| A. STANLEY WILLIAMS | Brighton | — | — | — |
| Rev. L. A. WILLIAMS | Brighton | — | — | — |
| W. H. WOOSTER | Ballarat | — | — | — |



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| Names. | Locality. | No. of Drawings. | Instrument. | Inclusive Dates. |
|---|---|---|---|---|
| J. WYKES | Bournbrook | 12 | 4½-in. O.G. | Dec. 12, 1894; Apr. 14, 1895. |
| H. F. GRIFFITHS | Streatham | — | 6½-in. spec. | — |
| E. W. ELLERBECK | Scarborough | — | 5-in. refrac. | — |
| JOS. LUNT, B.Sc. | Ealing | — | 3·5-in. refrac. | — |
| RALPH FALCON | Workington | — | 3·75-in. refrac. | — |
| N. LATTEY | Cardiff | — | 8½-in. spec. | — |
| F. K. MELLOR | Huddersfield | — | 5-in. refrac. | — |
| J. ORR | Glasgow | — | 3·25-in. refrac. | — |
| WM. ANDERSON | Madeira | — | 5-in. spec. | — |
| ED. HALL | Finland | — | 5-in. spec. | — |
| Total | | 324 | | |
| Extra drawings | | 27 | | |
| Total | | 351 | | |

In this table we have accounted for all the drawings that have come to hand during the apparition. Some of these have been published in the "Journal" of the Session; others sent to the New South Wales Branch. A few have been detained for special use or reasons, but not those for cyclical purposes, and will be accounted for in due course.

A few of the drawings are in black and white to suit the Collotype process of reproduction, should the Council adopt it. It is, however, but fair to say that nearly all the Members very much prefer Mr. Green's forms, and that reproductions, if less numerous, should be tinted. The total number of finished drawings on Green's forms is 272. The number on paper or card, inclusive of charts and separate markings, is 86, making a total of 358 drawings of all kinds for the apparition, a number which indicates an amount of application to work which is very satisfactory to all concerned. It is thought that the general character and artistic quality of the drawings have advanced, and also that the accuracy of the delineations will bear comparison with previous efforts. Nearly all the drawings have been tested in this respect. The latitude of the belts has been specially attended to.

The longitude of important markings, and of the central meridian is fairly correct in nearly every case, and has been generally computed by the observers themselves.

The interim reports that have frequently appeared in the "Journal" really form an integral portion of this Memoir, and should be read in connexion with it. As heretofore these occasional notes have been found stimulating and guiding to co-workers. The Director has never before known so many and prolonged climatic hindrances occurring as when Jupiter was most accessible



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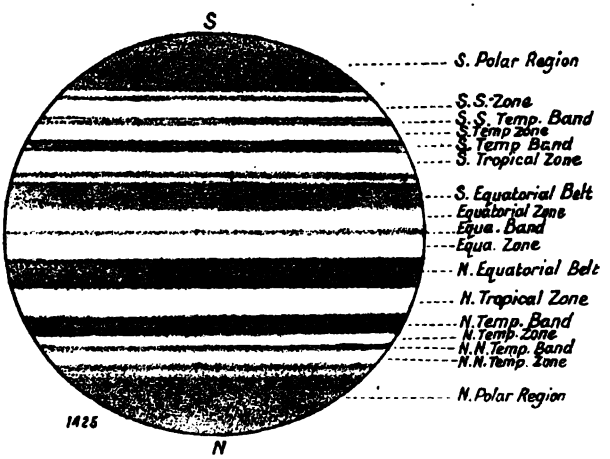
for observation, and yet the amount of work done and the number of observers have exceeded that of previous years. The total number of good nights when the planet was nearest opposition (viz., in October to February) was only 33, of which 10 were in December, and these five months include the prolonged frost. These climatic hindrances referred to are chiefly to counsel observers to avail themselves of the earlier months of the apparition, and, if circumstances permit, of the early hours of the morning, when the air is generally at its steadiest.

We are glad to know that the adopted terminology has been invariably used by the Members of the Section, and that it has been approved by experts outside the Section. It is hoped that it will one day become universal.

To assist in making the names still more definite, the diagram is reproduced here, and it may be remarked that the latitude of the belts and bands is fairly well preserved, making allowance for a slight but well ascertained shifting.




The Members of the Section desire again to express their deep indebtedness to Dr. Marth for his invaluable Ephemerides. They also desire to express their acknowledgment of service rendered to the Section by Mr. A. Stanley Williams, whose great experience has been laid under contribution from time to time. Encouraging words have come to hand from eminent astronomers at home and abroad, showing that the work of the Section is not unappreciated. For such friendly notice the Section is grateful.

To the 50 members of the Section the Director cannot but present his cordial thanks at once for their hearty co-operation and forbearance; some of the more active have literally overwhelmed him with communications and interrogations, the latter not always purely sectional. Some seem to have thought that a Director must be an encyclopedia of reference in all departments of astronomy. The Director has always endeavoured to reply, or



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has referred them to those who could, believing that mutual correspondence is a bond of strength.

Some sectional papers have been read at the Branch Meetings of the Association; notably one "On the Observation of Jupiter," intended chiefly as a message of friendly interest to the Jovian students in the New South Wales Branch. It is hoped that, while promoting local activity, it will cement the union with the parent association, and will possibly lead to the sending of similar return messages.

Three small portfolios of drawings have been circulated, one being specially designed for the use of the English Branches. It is believed they do more than satisfy curiosity as to what others are doing, being instructive and stimulating.

The Director has arranged, according to longitude, nearly the whole of the drawings to hand in a suitable album. They will be deposited in the Library for future reference, and it is intended that the same should be done for the drawings of the four previous apparitions. Facilities for their study will doubtless be afforded by the librarian. Captain Wm. Noble's suggestion of the probable cyclical motion of the Jovian markings is on the eve of being fully discussed, and though it will necessarily take considerable time, it is hoped that the Jupiter Section of the British Astronomical Association will take a fair share in the work.

As in previous memoirs, Part I. is preliminary and an outline of work achieved. Part II. is a condensed description of work and include the manuscripts of some of those Members who have presented their returns in a collected form. As many of the Members have only been able to indicate their work in letters and postcards, this disjointed form could only appear in the condensed results. Part III., as heretofore, is a tabular statement of satellite returns, happily somewhat more copious than on previous occasions, though still rather disappointing in quantity. It is hoped, however, that there is evinced increasing care and accuracy. Part IV. is the usual résumé of the more important observations of the Section, with brief remarks on the same.

In these four parts it is felt that the veriest outskirts of Jovian knowledge have only been reached, that what lies beyond present grasp is the immensely larger portion of the subject; nevertheless, what has been done is our acquired standpoint for further discoveries. The real need of Jovian students at present, is a comprehensive work on the planet corresponding in style of treatment with that of the now classical work of M. Flammarion on "La Planete Mars." It is hoped that the French astronomer, or some one who is fully competent, will undertake this task, and if the Jupiter Section of the British Astronomical Association can in any way aid in the production of the monograph it will not have existed in vain. Should any Member of the Section be moved in this direction, the Director will be glad to act as the temporary recipient of data, papers, or drawings.

The Rev. T. H. Foulkes, one of the most diligent and successful sectional workers, has suggested the desirability of any given



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observer paying special attention to a certain portion of the disk, in addition to the more general delineation. The Director does not see this to be an over-refinement of the division of labour. But what may be regarded as the outlying and less noticed portions of the disk should not be neglected in the individual selection, as they are more likely to afford perfectly new discoveries. Any supposed new feature should be at once submitted to the Section for corroboration, and the Director, as a rule, should know what portion of the disk is made a spécialité. The Polar regions have been too often relegated to later times of observation, and are often slurred over as presenting usually a blank aspect. These portions are, however, full of interest, as several of the drawings during the late apparition abundantly show; some of these features will be specified in Part II.

At a Meeting of the Association held on April 24, 1895 a series of 15 lantern slides representing an entire rotation of Jupiter's surface was exhibited by the Treasurer. The slides were prepared from drawings of the planet taken by Herr Brenner at the Manora Observatory. On May the 29th there was exhibited, at the close of the Meeting, by Mr. G. T. Davis, 70 beautiful drawings on Mr. Green's forms, as taken by Herr Brenner during the apparition, and showing nearly all the features of interest seen in 1894–95. This exhaustive series of Jovian sketches is especially noteworthy as exhibited by a Member of the Section, whose patient skill and diligence is exemplary, an example (the Director is pleased to add) not without fruit in the returns from several of the other Members, and stimulative of yet future work.

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## PART 2.

The most notable features of the apparition are, in brief, as follows: Discussion of these and other features will be found in Part IV.:—

1st. The partial revival of the Great Red Spot.

2nd. The two equatorial belts have been unusually agitated during the whole apparition.

3rd. The equatorial zone has been fertile in changes.

4th. The two temperate bands have been comparatively quiescent.

5th. The Polar regions have not been without interest.

The N. Polar regions have generally presented the usual bluish tint.

The S. Polar region has been darker than usual, occasionally nearly as dark as the N. It has also shown a ringed appearance similar to the northern.

As in previous "Memoirs" the surface has been divided into six sections for the sake of comparison; each section comprises 60° of longitude, that is, the distance each side of the central meridian will be about 30°, as such an arrangement fairly avoids the distortions incident to curvature of surface. Reference to



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the "Memoirs" for 1891 and 1892 will explain this fully. Change in the latitude of the belts is clearly established.

These changes should be carefully noted with a view to discover the cause. It is a well-known fact that the spots and other markings do not rotate uniformly, and by noting the changes in latitude conjointly with the periods of the spots, discoveries may possibly be made. The shifting of the temperate belts is so manifest as to render eye observations useful, and Slade's micrometer, a cheap and easily used apparatus, may be profitably employed in this work.

As heretofore in the preparation of Table II., nearly the whole of the drawings have been utilised, about 350 in number. Drawings not reproduced in this Memoir will be inserted in the album. As before, certain drawings have been marked by the Director as suitable for reproduction from which the Council will make a selection.

It may be well to note that, as heretofore, the longitudes have been computed according to Marth's tables, System II., and that this year the Director's labour in computation has been very light, as compared with previous occasions, as many of the workers have computed their own latitudes.

The Director recommends the excellent manual by Messrs. Barlow and Bryan in the University Tutorial Series, entitled "Elementary Mathematical Astronomy," published by Clive and Co., of Booksellers Row, London. Such a book should be fairly mastered by all planetary observers. It is believed that the great majority of Jovian students are anxious to be thorough.

Photographs taken at the telescope only bear enlargement when the aperture is very considerable, and as a clock movement is indispensable as well as a high class enlarging camera, it is scarcely to be expected that the Section will employ the camera at the telescope; but the copying of very careful and unusually interesting drawings will not only multiply copies for friends, or other societies, but certainly induce and cultivate that habit of accuracy so essential to observational success.

In the present list of drawings the range is from August 25, 1894, to May 10, 1895.

As will be perceived, the arrangement is the same as previous Memoirs.

*Section I., longitude* 0° *to* 60°.—There are 60 drawings in this Section; 42 drawings are wholly available for comparison, making, of course, allowance for diversities of dates, of apertures, and powers used, and of those varieties of draughtsmanship which must always characterise diverse observers; 37 of these drawings show more or less distinctly the Great Red Spot. It is shown in several quite plainly near the limb, indicating very favourable seeing conditions. In several drawings the ringed aspect and the darker following end is shown. "The shoulder is plainly shown " in all the drawings, and as in former years its angle with the " belt varies. This is thought to be a proof of variability in this " feature, though it may still be said that there is no more " permanent one on the disk. The ligament uniting the Red " Spot with the shoulder is not shown in any of the sketches



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" except two by Mr. Henderson, though features of equal " delicacy are indicated. There is, however, no doubt of its " existence. Nearly all the charts hitherto inspected by the " Director include it. This points to variability in this thread-" like feature. It is vain to look for it except in the very best " seeing conditions." In 32 drawings the faint equatorial belt is shown, justifying the belief that it is plainer this apparition than during recent ones. The light and dark markings in the equatorial zone are more numerous and distinctly shown than heretofore. The drawings of Herr Brenner, Dr. Paterson, Messrs. Henderson and Roberts are noteworthy for this. The disturbed condition of the N. equatorial belt is plainly shown in every sketch; in some it is very pronounced. It should be noted that as Mr. Roberts uses a Herschelian reflector, the disk is represented as reversed, but not inverted. A noteworthy drawing in this section is the one by Mr. Henderson above referred to.

*Section II., longitudes* 61° *to* 120°. There are 47 drawings in this section. The faint equatorial belt is shown in 31 sketches. The delicate wisps are shown in drawings by Messrs. Roberts and Henderson. The white markings and mottling on the equatorial zone are shown in nearly all in this section. The disturbances in the two equatorial belts are shown in all, especially by Messrs. Paterson, Henderson, Foulkes, Brenner, Hallowes, and the Director. The delicate rifts in both belts are plainly shown by Herr Brenner, Messrs. Corder and Mee. The N. temperate band is very plain in nearly all the drawings, and in nearly every case is shown in a quiescent condition. Its greenish tinge is seen in several sketches. The Polar regions are normal, Dr. Paterson showing the tints very strongly.

*Section III., longitudes* 121° *to* 180°.—This section comprises 43 drawings. The faint equatorial belt is shown in all. The delicate wisps are seen in drawings by Messrs. Antoniadi, Roberts, Molesworth, and Paterson. The disturbed condition of the N. equatorial belt is well shown by Messrs. Corder, Davis, Brenner, the Director, and others. The rifts in the S. equatorial belt are shown by the same observers. The forked appearance of the same belt is shown in several of the drawings. The temperate bands are normal, as in previous section. Several light spots are seen on the S. temperate band in drawings by Herr. Brenner, Messrs. Paterson, Roberts, and the Director. The ringed aspect of the N. Polar regions is shown in drawings by Messrs. Goodacre, Mee, Davis, and Wykes. A dark marking is shown in the N. Polar regions by Lieut. Molesworth. Mr. Mee shows two striking red spots, N. edge of N. equatorial belt, in longitude ± 140°. A rift in a drawing by Mr. Goodacre in the same belt in drawing No. 158 is very unusual in form.

*Section IV.* comprises drawings whose central meridians range from 181° to 243°. There are 44 drawings in this section, in which the following are perhaps the most striking features. The equatorial zone is fairly well shown, especially in sketches by Messrs. Henderson, Paterson, Roberts, &c. The latter showing the wisps in drawing 232. Messrs. Saul and Antoniadi also show these delicate features. The faint equatorial belt is shown in all.



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The reason for dwelling on this zone is that it shows the seeing must be excellent, and the other features in the sketch are probably unusually good and accurate. The disturbed condition of both equatorial belts is shown in nearly all the drawings; in a marked manner by Messrs. Foulkes, Cope, Brenner, Paterson, Roberts, Antoniadi, Ellis, Henderson, Corder, Saul, the Director, &c. The temperate bands are comparatively undisturbed, Herr Brenner, however, shows peculiar dark markings on the N. temperate band in longitude 186°. A striking feature in this section is a red longitudinal belt on the N. tropical zone, in a drawing by Rev. T. H. Foulkes (longitude of central meridian 239°), and the divided and curved aspects of the S. temperate band in the same drawing. This additional quasi band is corroborated as to form and position in drawings by Messrs. Paterson and Roberts. The Director has several times suspected it. On the N.N. temperate band Herr Brenner shows dark markings in drawing No. 163. The colouring and the ringed aspect of the N. Polar regions is shown in eight drawings. The rings on S. Polar regions are also shown in six drawings.

*Section V.* comprises 42 drawings ranging in longitude from 241° to 300°. Messrs. Offord, Paterson, Roberts, Corder, Cammell, Ellis, Henderson, and Molesworth show the mottling on the equatorial zone. The delicate equatorial belt is shown in all, especially by Messrs. Cammell and Foulkes. The disturbances in the N. and S. equatorial belts are shown in nearly every drawing, Messrs. Maw, Paterson, Foulkes, Henderson, Mee, Molesworth, Corder show white spots or rifts in both belts. The temperate belts are plainly shown. Light spots are shown on the Polar regions in sketches by Dr. Paterson. Noteworthy drawings by Rev. T. H. Foulkes, especially one in long. 260°, show three transverse rifts on the N. equatorial belt, two being accompanied by dark markings. The drawing by Mr. Goodacre (long. 286°) shows a curious rift on the S. equatorial belt. The sketch by Dr. Paterson (long. 294°) is a most remarkable one, showing, as it does, with great minuteness the disturbances in the N. equatorial belt. Mr. Saul's drawing, long. 248°, is similar. Mr. Henderson's drawing, long. 261°, is a striking one.

*Section VI.* includes longitudes 301° to 360°. In this section the Red Spot is shown in 20 drawings, and the shoulder formation in nearly all. The delicate equatorial belt is shown by Messrs. Brenner, Roberts, Mee, Henderson, Ellis, Foulkes, and the Director. The light markings are well shown in the drawings by Herr Brenner, and Roberts. The dark wisps are well shown in drawings by the latter, a fair specimen being seen in sketch, long. 356°. The N. and S. equatorial belts are shown rifted and much disturbed, large white spots or markings being shown in drawings by Messrs. Corder, Foulkes and others. The temperate bands are fairly well shown in nearly all the drawings, notably by Foulkes, Henderson, Goodacre, Davis, Brenner, Antoniadi, Mee, and Ellis, &c., the latter showing a singular curve in long 333°. There is a noteworthy drawing by Mr. Corder (long. 350°) showing an unusually large white marking on the N. equatorial belt. Mr. Wykes shows some singular markings connecting the N. equatorial belt with the N. temperate band, long. 354°. The



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drawing by Mr. Wykes (long. 355°) of a later date shows striking markings on the N. equatorial belt. Those by Mr. Corder (long. 360°) and by Mr. Goodacre (long. 309°) are also noteworthy.

The supplementary drawings consist chiefly of 27 black and white sketches by Herr Brenner. They are the originals of those which appeared in the **E.M.** The faint equatorial belt is shown in every drawing and the wisps in nine of them. The series bore the testing for accuracy in latitude remarkably well, especially as position was obtained by eye estimates.

The following is a description of 21 drawings selected as representative of the work of the Section. The descriptions are as nearly as possible in the language of the Members. To describe the whole 350 would be far beyond printing limits. Where the returns have been carefully arranged, and are in presentable form, they will be sent to the Library with the MS. of the Memoir. The data which has come to hand in desultory form is retained by the Director for the present.

*Long.* 0° (*Waugh*).—The Red Spot clearly shown, the preceding end being very diffuse. The shoulder sharply curved, and the following end of the S. equatorial belt duplex. The N. equatorial belt deeply indented on its S. edge.

*Long.* 19° (*Henderson*).—The most notable features in this drawing are the Red Spot, seen darker on its S. and E. boundaries, and the delicate ligaments joining the Red Spot to the S. equatorial belt. The duplicity of this belt is well seen, the southern portion being the darker. The N. equatorial belt is seen much disturbed, with singular light rifts on the northern edge. The ringed aspect of the Polar regions is very marked.

*Long.* 21° (*Antoniadi*).—The Red spot and its aureola distinctly seen. Four dark spots attached to the N. edge of the S. equatorial belt. The N. equatorial belt much disturbed.

*Long.* 23° (*G. T. Davis*).—Two marked white spots are seen in the equatorial zone. The Red Spot is well defined. The N. equatorial belt is disturbed. Two very decided dark spots being shown on its N. edge.

*Long.* 32° (*Waugh*).—The Red Spot, definite at the following end, is clearly seen. The shoulder is dark and well defined. Both equatorial belts are duplex; on the N. edge of the N. belt there are several dark spots interspersed with white ones. The faint equatorial belt is well seen. The N. temperate band had a greenish tinge. The N. Polar regions are plainly ringed; air good.

*Long.* 36° (*Maw*).—Red Spot very plain at following end. The shoulder very definite. The faint equatorial belt well seen. The N. equatorial belt had a peculiar angular marking that seemed to spring from a dark spot on the N. edge, and reach the S. edge. Four white spots are seen on the N. edge. The N. temperate belt is definite, and the ringed aspect of the N. Polar region is well seen. The shadow of Sat. I. is shown in transit.

*Long.* 89° (*Mee*).—The faint equatorial belt shown. Dark spots on N. edges of the equatorial belts. The S. and N. temperate bands clearly shown.



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*Long.* 102° (*Davis*).—The N. edge of the N. equatorial belt seem disturbed. Four dark well-defined spots on it. The N. temperate band dark and distinct.

*Long.* 104° (*Paterson*).—The faint equatorial belt seen from limb to limb. The S. equatorial belt much disturbed. A curious light spot surrounded with dark extensions from the body of the belt. Several other light markings on the belt. The N. equatorial much disturbed. A wavy light marking at the following end, and four prominent dark spots on the N. edge. The N. temperate band very distinct; its N. edge being irregular. The N.N. and S.S. temperate bands seen. A very striking drawing.

*Long.* 195° (*Kempthorne*).—Both equatorial belts much disturbed. Four white spots on the N. edge of the N. equatorial belt.

*Long.* 227° (*Davis*).—The copperish tint seen in both equatorial belts. On the N. edge of the N. equatorial belt were seen three dark spots reaching the N. temperate band.

*Long.* 261° (*Henderson*).—A drawing very full of detail. Three light wisps on the equatorial zone. Also the delicate equatorial belt. The S. equatorial belt duplex in preceding part. Wavy in outline, with dark markings. The N. belt copper coloured and spotted with dark and light spots, over 14 in all. A dark marking on the S. temperate band, S.S. and N.N. temperate bands.

*Long.* 269° (*Roberts*).—Dark spots on the N. edge of the S. equatorial belt, which is seen duplex. The N. equatorial belt much disturbed. A light spot on the equatorial zone, also a large one on the preceding portion of the N. tropical zone. Both temperate bands plainly shown.

*Long.* 282° (*Henderson*).—A serrated line on the N. edge of the S. equatorial belt, very delicate. The N. equatorial had a shaded aspect, with light spots on N. edge. The temperate bands seen. The Polar regions bounded.

*Long.* 309° (*Goodacre*).—Bifurcation of the S. equatorial belt well seen. Also an extension below the fork. The N. belt is seen disturbed, with light and dark markings on it. The two temperate belts well seen. Polar regions dense.

*Long.* 318° (*Antoniadi*).—The Red Spot clearly seen, The shoulder well marked and high. The S. equatorial belt divided in preceding part. Three dark spots on N. edge with two wisps extending from them. The N. equatorial belt very disturbed, with spots extending from it on the N. tropical zone. A large white spot on the preceding portion. The two temperate bands seen.

*Long.* 330° (*Saul*).—Both equatorial belts dense, with light markings. The equatorial zone mottled, two definite light spots. Both temperate bands well seen. Also the N.N. temperate band well seen. S. Polar region dense.

*Long.* 334° (*Henderson*).—The Red Spot seen with a portion of the trail. The equatorial zone mottled with definite light markings. The delicate faint equatorial belt seen. The N. equatorial showing some singular dark markings along the S. edge. The S. Polar region well seen.



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*Long.* 337° (*Waugh*).—The Red Spot shown. Also the shoulder, sharply curved, and the faint equatorial belt shown. The N. equatorial belt much disturbed with light spots on the S. edge, and dark spots on the N. one. The N. and S. temperate bands well shown.

*Long.* 337° (*Wykes*).—The equatorial belts shown, with dark spots and wavy markings. The N. and S. temperate belts shown. The S. Polar region darker than the N., an unusual feature, shown in a few of the unpublished drawings.

The above 21 drawings are only specimens of the work done. The remainder of the over 350 drawings is well worth study and description, most of them being full of interesting detail.

The following is a brief description of charts sent in :—

Mr. Henderson sends a full chart of Jupiter as obtained by observations in 1894 and 1895. It shows the equatorial belt as somewhat deviating from the equator of the planet, being several degrees N. at its preceding portion. The latitude of this belt, as obtained by averages, is 2° 1′ S. Seventeen large white markings are shown N. of the equator and 21 S. of the equator. It is difficult to define the exact number of wisps, but there are about 12 of these delicate features. The S. equatorial belt is shown duplex in its entire length, with two rifts reaching each edge. There are about nine dark markings on the N. edge, partly merging into each other, and two on the S. edge. There are also two light markings on the same edge. The Red Spot is shown very definitely, the zero longitude being about its centre. The S. temperate band has two dark spots, and in its preceding portion has nine white spots on its surface. They range from long. 230° to near 340° (a feature of great interest). The N. equatorial belt has one large dark spot near the zero meridian. Also a similar one in long. 120°. The other dark markings are chiefly on the N. edge of the belt, and merge into each other. The dense marking in long. 130°—160° ± is shown on most of the drawings, and was a marked feature of the apparition. There is a rift through the belt in long. 350 ±. This also was much observed. There are 22 light spots on the N. edge of this belt. The N. temperate band is shown irregular, with markings. The labour connected with the construction of this chart was amply rewarded by greatly increased power and grasp over the planet's disk. It is hoped the example will be followed with the addition of latitude graduation.

Herr Brenner sends a chart of the entire visible surface. The faint equatorial belt is shown to increase in S. latitude at its following end, with a darker marking in long. 295°—310°. The Great Red Spot is shown with its centre at about 5°. There is a long rift on the S. equatorial belt, extending from long. 185°—261°. The forked portion of the belt extends from 272°—348°. Another rift extends from 12°—90°, dividing the shoulder, which is unusual. Another rift extends from 140°—188°. There are nine dark spots on the N. edge of the belt, and seven light ones in addition to the mouths of the rift. There are 12 light spots on the equatorial zone, and a few dark shades. On the



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N. equatorial belt there are six short rifts, and nine dark spots, and 11 light ones. On the N. temperate band eight light spots and some dark markings. The two S.S. and N.N. temperate bands are shown, with two spots on the former. The light marking shown by dotted lines on the N. edge of the N.N. temperate band is unusual, but the most marked feature are the conical and square large dark masses on the N. and S. Polar regions. The former has been frequently seen by other observers.

It is hoped that Herr Brenner's zeal and industry in chart marking will stimulate all the Members of the Section to follow suit. While requiring care in fixing the longitudes it is not so difficult as appears at first sight.

Mr. Roberts sends a chart of the entire disk from observations between the 10th to the 28th of April 1895. It shows 19 wisps and four broader markings proceeding from equatorial belt to equatorial belt. Also 19 light spots or markings, and the faint equatorial belt on the equatorial zone. A truly wonderful collection of objects. The S. equatorial belt is duplex almost throughout its entire length. The duplicity being interrupted N. of the Red Spot and four other places by light markings. There are 19 dark spots on the N. edge, and five, more or less distinct, on the S. edge of the belt. The Red Spot is shown with its centre on the zero meridian. On the N. edge of the N. equatorial belt there are 21 light spots and 18 dark spots. The S. tropical zone has 14 light spots or markings, and the S. temperate band has seven dark markings. The S. temperate zone four white markings with traces of others. The N. temperate band has seven dark spots or markings. There is one light marking on the S. Polar region.

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## PART 3.

### Satellite Observations.

The returns in this department of Jovian work, though somewhat more copious than heretofore, are still below the requirements of its importance. An indicated time, if doubtful, is of little scientific value. Meanwhile the approximation attained by a quadrant, a good watch, and the aid of the nearest post office clock, when carefully used, is not altogether valueless, and is certainly a good training in accuracy. The observations of Callisto, as suggested by Dr. Downing, have again been excellent practice in this class of observing, and the mean results are interesting and possibly a basis for calculating purposes. The observation of relative albedo and colouring has been going on, and the ultimate results will be of value. The following tabular statements are selected of a highly trustworthy nature. The Director purposes for the apparition of 1895–96 to furnish forms based on those in use among acknowledged experts in which the fading and extinction in satellite eclipses, the external bisection and internal contacts will be indicated in occultations and transits, and remarks on any peculiarities during observation may be given. The best qualified observers in the



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Section are quite prepared for this order of work, so it is hoped that the apparition of 1895 and 1896 will afford useful data for computation.

The form of satellite No. I. having been set at rest by the masterly observations of Prof. Barnard, supposed oblateness will no longer be a subject of inquiry in the Section. Barnard's published measures of size have practically taken out of the hands of amateurs that and kindred subjects, leaving, however, eye estimates of albedo and tint within range. Observers are again referred to the excellent paper on satellite observation by Dr. Downing, written mainly for the instruction of Members of the Jovian Section, and printed in the "Journal," for November 1890. Recent Members of the Association who contemplate satellite work should make the article their *vade mecum*.

The Rev. S. J. Johnson's paper is given intact. His expertness and experience entitling him to the foremost place in this department. It is as follows:—

"The sharp weather that prevailed in the early months of 1895 was favourable for observation. The occultation of the Pleiades on the 7th of January, and the total eclipse of the moon on the 11th of March being seen without an intervening cloud. In the following list of eclipses of Jupiter's satellites, poor observations are omitted.

"1894.—October 26. Satellite I. Eclipse D. Fading $11^h\ 50^m\ 20^s$. Disappeared $11^h\ 51^m\ 42^s$.

"December 4. Satellite I. Eclipse D. Fading $10^h\ 17^m\ 23^s$. Disappeared $10^h\ 18^m\ 8^s$.

"1895.—January 5. Satellite I. Eclipse R. First perceptible $9^h\ 6^m\ 10^s$. Bright $9^h\ 7^m\ 37^s$.

"January 7. Satellite III. Eclipse R. First visibility $7^h\ 45^m\ 11^s$. Bright $7^h\ 47^m\ 56^s$.

"January 11. Satellite II. Eclipse R. First visibility $8^h\ 48^m\ 59^s$. Bright $8^h\ 51^m\ 2^s$.

"January 28. Satellite I. Eclipse R. First glimpse $9^h\ 21^m\ 13^s$. Bright $9^h\ 22^m\ 55^s$.

"February 4. Satellite I. Eclipse R. First glimpse $11^h\ 16^m\ 21^s$. Bright $11^h\ 17^m\ 33^s$.

"February 5. Satellite II. Eclipse R. First seen $5^h\ 52^m$. Bright $5^h\ 53^m\ 4^s$.

"February 6. Satellite I. Eclipse R. First glimpse $5^h\ 45^m\ 9^s$. Bright $5^h\ 46^m\ 20^s$.

"February 12. Satellite II. Eclipse R. First glimpse $8^h\ 27^m\ 12^s$. Bright $8^h\ 28^m\ 44^s$.

"February 13. Satellite I. Eclipse R. First glimpse $7^h\ 41^m\ 5^s$. Bright $7^h\ 42^m\ 19^s$.

"February 19. Satellite III. Eclipse R. First glimpse $7^h\ 54^m\ 2^s$. Bright $7^h\ 55^m\ 39^s$.

"Satellites then arranged in a triangle:—

"February 19. Satellite II. Eclipse R. First glimpse $11^h\ 2^m\ 43^s$. Bright $11^h\ 4^m\ 8^s$.

"February 20. Satellite I. Eclipse R. First glimpse $9^h\ 36^m\ 45^s$. Bright $9^h\ 38^m\ 56^s$.

"April 7. Satellite I. Eclipse R. First glimpse $10^h\ 9^m\ 34^s$. Bright $10^h\ 12^m\ 5^s$.



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"On January 4th made a near approach to 1 Geminorum. The star seemed 1 mag. brighter than his third satellite. I examined the distances of these two or three times during clear intervals at $10^h\ 27^m$, they were about 60″ apart. On the 5th the same star was just N. of the second satellite, at $9^h\ 15^m$ by micrometer, it was 48″ off. Its reddish tinge caused a noticeable contrast of colour."

Lieut. Molesworth returns as follows:—

Time taken by seconds watch corrected to town time (Hong Kong) at the nearest hour. These are therefore chiefly interesting, *inter se*.

1895.—Transit of Satellite II. January 6. Shadow on central meridian $6^h\ 43^m$. Satellite first visible on disk $7^h\ 11^m\ 30^s$. Internal contact, 1st, $7^h\ 16^m\ 20^s$. Satellite obviously against sky $7^h\ 18^m$. Half off $7^h\ 20^m\ 55^s$. External contact $7^h\ 23^m\ 10^s$. Clear black division between limb of ♃ appearing slightly flattened $7^h\ 25^m\ 20^s$.

I thought in several cases I saw a penumbra to the shadow, but could not be certain as the definition would only allow of a power of 225.

1895.—January 8. Transit of Satellite I. 1st contact with limb $5^h\ 52^m\ 40^s$. All on disk $5^h\ 55^m\ 10^s$. Shadow, 1st contact $6^h\ 17^m\ 10^s$. All on disk $6^h\ 19^m\ 30^s$. Satellite on central meridian $\pm\ 6^h\ 56^m$. Shadow on central meridian $7^h\ 18^m$.

Shadow intensely black and seemingly larger than the satellite. Satellite only visible with difficulty from $6^h\ 45^m$ to $7^h\ 8^m$, as it was on a lighter portion of the disk. Easily seen the rest of the time. Egress not seen.

1895.—January 23. Occultation of Satellite I. Approximately one diameter from the limb $6^h\ 24^m\ 30^s$. First contact $6^h\ 28^m\ 40^s$. Satellite vanished $6^h\ 32^m\ 30^s$.

Satellite appeared very bright, almost phosphorescent, in contrast with the dull limb of ♃, disappearance watched with 450 e.p. under perfect definition. The limb of the planet could actually be seen against the bright satellite, and the appearance was most striking when the latter was half covered. Final disappearance took place as I moved the telescope (the slow motion being stiff), but was within 5 seconds of the time noted.

1895.—January 25. Transit of III. Definition poor, drifting clouds. Satellite three diameters from the limb, $2^h\ 17^m$, when clouds stopped further observation.

January 29. Occultation of II. Definition fair, 375 e.p. Satellite within one diameter of limb, $6^h\ 30^m\ 45^s$ First contact, $6^h\ 33^m\ 35^s$. Disappearance, $6^h\ 3^m\ 40^s$.

The colours of the satellites not noted as a rule. Speaking generally, IV. now appeared invariably the faintest (though the second in size of the four), and of a pale blue tinge. III. a great contrast in brightness, and of a very delicate pale yellow. 9½ spec. used. Difference between Hong Kong and G.M.T. is $7^h\ 36^m\ 38^s$.



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Mr. Ellis returns as follows:—

1895.—January 9. Satellite II. in transit. External contact, $10^h\ 17^s$. Internal contact, $10^h\ 24^m\ 30^s$.
Appeared brighter than bright parts of planet.

1895.—January 20. Satellite I. in transit. External contact, $7^h\ 18^m$. Internal contact, $7^h\ 28^m$. Internal contact exit, $9^h\ 30^m$. External contact exit, $9^h\ 38^m$. Shadow on C.M., $9^h\ 5^m$.

January 21. Satellite occultation. Disappearance, $10^h\ 10^m$.

February 2. Satellite IV. Superior conjunction, air not very steady, $10^h\ 52^m$. Satellite appeared to graze along the planet in contact, flattening the disk of irradiation, and being itself dimmed as though partly hidden by Jupiter's atmosphere.

Rev. T. H. Foulkes returns as follows:—

Time as given by my chronometer, from which I can get absolute G.M.T. We get a signal from Greenwich every day.

1895.—February 19. Satellite II. c. visible easily to $6^h\ 11^m$. Time given in *Companion*, $6^h\ 8^m$. Satellite III. eclipse re-appearance as in *Companion*, $7^h\ 55^m$. Seen plainly at $7^h\ 53^m$. Quite out of shadow by $7^h\ 54^m$. Satellite II. in transit. Satellite quite clear of disk, $5^h\ 38^m$. Shadow completely off disk, $5^h\ 37^m$.

In fact, I should say the satellite and shadow egress were practically simultaneous. A very pretty sight.

1895.—March 5. Satellite III., occultation disappearance, $7^h\ 56^m\ 4^s$.

April 10. Occultation re-appearance. Satellite III. First seen, $7^h\ 2^m\ 40^s$. Quite clear, $7^h\ 3^m$. Times given in *English Mechanic* and *Companion*, $7^h\ 7^m$.

A lovely sight at about $7^h\ 20^m$. IV. and III. on either side of the N. Polar regions at equal distances looking like bright beads suspended; noted the great disparity in size. III. much larger than IV., which seemed to decrease in apparent size in comparison, both moving westward.

Satellite IV. Occultation disappearance, $8^h\ 4^m$. Satellite IV. Occultation reappearance, $9^h\ 42^m$. E.M. times, disappearance $7^h\ 55^m$, reappearance $9^h\ 48^m$.

A slow weary movement, jog-trot compared with the dash of Satellites I. and II.



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Mr. Meares reports as follows:—

1895.—February 19. II. Satellite. Occultation disappearance, about three quarters gone, $6^h\ 8^m\ 30^s$. Last glimpse. $6^h\ 10^m$. Satellite III. Eclipse reappearance, $7^h\ 54^m\ 56^s$. Satellite I. Transit ingress, $8^h\ 57^m\ 25^s$. Satellite II. Eclipse reappearance, $11^h\ 2^m\ 41^s$. Satellite I. Transit egress, bisected, $11^h\ 14^m$. Satellite I. Last contact, $11^h\ 16^m\ 35^s$. Satellite IV. Eclipse disappearance, $13^h\ 24^m$. Very gradual disappearance.

Mr. G. T. Davies returns as follows:—

1895.—January 21. Satellite III. Occultation. First contact, $9^h\ 59^m$. Total disappearance, $10^h\ 7^m$.

March 7, at $8^h\ 55^m$, observed the shadows of Satellites I. and II., one on the S. equatorial belt, the other on the S. equatorial zone, which appeared light grey. At times the satellite itself seemed a still fainter grey hue than the grey shadow.

March 16. The shadow of Satellite III. on S. temperate belt at $8^h$ above one-third of diameter from limb.

April 15. Satellite I. just off W. edge of disk at $8^h\ 14^m$, opposite N. edge of S. tropical zone, its shadow just past C.M. Satellite II. about its own diameter from limb.

Mr. Essam's returns:—

1895.—February 11. Occultation of Satellite I. Disappearance, $9^h\ 55^m$.

Satellite appeared very bright, even brighter than its primary. The occultation was exactly in a line with the N. equatorial belt. Its disappearance was very gradual, no hanging on noticed, air steady.

1895.—February 12. Satellite I. in transit. It appeared as a bright spot on the disk, casting a black, diffused, oblong spot on S. equatorial belt. Reappearance, $9^h\ 30^m$.

Its circular disk was well defined and much brighter than its primary.

Mr. Roberts returns as follows:—

| Phenomena. | Date. | Beginning. | Ending. | Air, &c. |
|---|---|---|---|---|
| | 1895. | h m s | h m s | |
| Ec. R. I. | April 7 | 10 7 30 | 10 9 30 | Unsteady. |
| Oc. R. III. | „ 10 | 7 4 28 | 7 6 30 | Steady. |
| Ec. D. III. | „ 10 | 9 3 8 | 9 5 36 | „ |
| Oc. R. IV. | „ 10 | 9 48 10 | 9 50 36 | Unsteady. |
| Oc. D. I. | „ 14 | 8 33 5 | 8 37 34 | Wind. |
| Tr. E. I. | „ 15 | 8 0 38 | 8 5 58 | „ |
| Tr. T. II | „ 15 | 8 19 0 | 8 25 8 | „ |
| Th. E. I. | „ 15 | 9 16 9 | 9 17 25 | Unsteady. |
| Sh. E. IV. | „ 19 | 7 5 30 | 7 11 0 | Bright twilight. |
| Ec. R. I. | „ 23 | 8 29 0 | 8 30 18 | Steady. |



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The watch used for these observations was timed by the Greenwich time ball, which falls 22 hours every morning at Wyatt's, Bournemouth.

Mr. Goodacre returns as follows:—

1895.—March 22. Satellite I. Occultation disappearance, $8^h\ 15^m$. Appeared fully $2^m$ on limb as a faint white projection (cone-like) disappearing about the middle of the N. equatorial belt.

The Director's Return (a selection).

| Date. | Sat. | — | Phase. | G.M.T. h | m | s | Remarks. |
|---|---|---|---|---|---|---|---|
| 1894. Dec. 4 | I. | R. | Beginning to fade. | 10 | 16 | 15 | Time occupied by phenomena, $1^m\ 15^s$. |
| | — | Dis. | Quite gone | 11 | 17 | 30 | |
| „ 12 | I. | *t* | External contact. | 9 | 46 | 0 | Poor observation. |
| „ 20 | III. | *t* | Do. | 7 | 25 | 30 | Hindering clouds. |
| | — | *t* Sha. | Do. | 7 | 11 | 0 | |
| „ 27 | III. | *t* | Do. | 10 | 41 | 0 | Hindering causes. |
| | — | *t* Sha. | Do. | 11 | 11 | 0 | |
| „ 29 | I. | E.R. | Bright | 7 | 12 | 0 | Good observation. |
| „ 31 | IV. | Sup. $\delta$ | $\delta$ | 5 | 38 | 0 | *Companion* time, $5^h\ 33^m\ 5^s$. Callisto seemed to graze the limb. Cloud prevented observation of tangent time. |
| 1895. Jan. 4 | II. | E.R. | Bright | 6 | 13 | 30 | *Companion* time, $6^h\ 13^m\ 8^s$. |
| „ 7 | III. | E.R. | First view | 7 | 47 | 5 | Good observation. |
| | — | — | Bright | 7 | 49 | 45 | |
| „ 18 | II. | Occ. | External contact. | 7 | 28 | 5 | |
| | — | — | Bisection. Internal contact. | 7 | 32 | 20 | Well seen on limb. Not observed. |
| „ 21 | I. | E.R. | First view | 7 | 26 | 0 | Fair observation. *Companion* time, $7^h\ 25^m$. |
| | — | — | Bright | 7 | 29 | 0 | |
| „ 28 | I. | Occ. | First contact | 6 | 12 | 30 | Good observation. |
| | — | — | Last contact | 6 | 15 | 15 | |
| Feb. 19 | III. | E.R. | First view | 7 | 54 | 30 | Good observation. |
| | — | — | Bright | 7 | 59 | 0 | |
| May 1 | II. | Occ. | Last contact | 8 | 15 | 0 | Cloud. |
| Jan. 25 | IV. | — | — | 6 | 14 | 0 | Callisto at tangent. |
| Feb. 5 | II. | E.D. | Fading | 5 | 52 | 0 | Poor observation. |
| „ 27 | IV. | 3 $\delta$ | — | | — | | Time uncertain. |
| Mar. 7 | II. | Sha. | Ingress | 8 | 16 | 0 | Cloud hindering. |
| | — | — | Egress | 10 | 57 | 0 | It was interesting to see the shadow of I. overtaking the Sh. of II., and pass it. |
| | I. | *t* | Last contact | 10 | 45 | 0 | |
| | II. | — | Do. | 10 | 57 | 0 | |
| Apr. 3 | III. | E. | Fading | 5 | 6 | 0 | Three minutes from first view to fully bright. |
| | — | — | Bright | 8 | 4 | 0 | |



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## PART 4.

This part, as heretofore, will consist of a brief summary of the sectional work, and a few deductions therefrom.

1. Marked progress has decidedly been made in the latitude and longitude of the belts and markings. Well ascertained changes have been noted and recorded. A standard scale has been taken as a reference, the eye has been cultivated, and though there has been necessary diversity in style and ability; it is believed that the disk positions are more trustworthy than heretofore.

2. The colouring of the belts seems to have been caught by a larger number of Members during the apparition. This arises partly from an increase of aperture, but chiefly from closer attention, and the resulting development of the colour sense, and even in some few cases where Green's forms have not been used, the belt and spot tints have compelled record. Messrs. Corder, Paterson, Brenner, Foulkes, are among the leaders in this feature. In delicacy of tone, the drawings of Messrs. Cammell, Henderson, Maw, and Mee, leave little to be desired. In the later period of the apparition, the more delicate features of the planet were distinctly seen. Mr. Robert's numerous and interesting sketches are a striking instance of this.

3. Again the Director, in justice to his co-workers, feels bound to call attention to the diversities of instruments, air, vision, and experience which must ever characterise a large body of observers and as fully accounting for differences in delineation. Permit reference to the opening portion of Part IV. of the last Memoir.

We proceed to deductions from the large amount of observations and drawings to hand. First, the Great Red Spot has certainly been as visible and as ruddy as during last apparition. It is shown in 56 drawings as against 22 in last report. It is generally darker at the following end and diffused at the preceding, the faint aureola is only slightly indicated, there is no evidence that the spot shifts in latitude, but the S. temperate band is sometimes attracted by it. Light vapours sometimes overlie its central portions. It is the current opinion that the Red Spot is not strictly atmospheric but a protuberance from the more solid or viscous body of the planet, and the slender ligament connecting it with the S. temperate band remains a mystery.

Mr. Wykes suggests that the Great Red Spot is not strictly a spot at all, but a reflection of lurid light from the fires of an active volcano on the solid body of the planet. He thinks that the density of the planet's atmosphere would partially stop, and disperse the fiery light, and cause it to appear like flame behind ground glass. This theory would account for variability, and also for the gradual decay of luminosity since its maximum, though it hardly accounts for its ringed appearance, or for the diffuseness of its preceding end. The suggestion is nevertheless well worth further consideration, and careful observation with reference to it. Though the Section, as a whole, is not given to theorising, there can be little objection to the suggestion of causes of phenomena by such careful and industrious observers as

1 p. 4721.



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Mr. Wykes. Other observers speak of it as if seen through a veil.

The equatorial zone has received more attention this apparition, and the faint belt is shown on 158 drawings. It has sometimes appeared wavy and unequally dense. There is reason to believe that it is continuous, its broken aspect being due to overlying vapours. Early drawings of the present apparition indicate increasing visibility. The most interesting, and certainly the most variable of the features of this zone are the strange wisps, sometimes crossing from belt to belt and generally springing from a dark spot. Observers vary much in their delineations, but atmospheric conditions are all powerful here.

The S. equatorial belt has rivalled the N. in activity during the latter part of the apparition. The shoulder, its most prominent feature, has never been more dark and distinct. Its angle with the belt varies several degrees. It is a question of great interest to what extent it is influenced by the Red Spot. The next remarkable feature is the bifurcation of the belt preceding the Red Spot. It is difficult to ascertain its extent as the ends are ill-defined, but from a comparison of drawings it cannot be less than 190° in length, or about 76,000 miles, more than three times the circumference of the earth; the width varies considerably, if the drawings do not err. It is far more prominent than during last apparition. Its edges are fairly defined but no markings have yet been seen within the fork, although the light and dark spots have been detected on its edges. Strange rifts, long, short, curved, straight, are shown by all observers. These are probably overlying vapour driven by currents, and sometimes so far longitudinally as to give apparent duplicity to the belt. Can they be the ejecta of volcanoes far beneath the outer atmosphere of the planet?

The N. equatorial belt, although much disturbed, was less so than last apparition. Possibly the two equatorial belts are disturbed alternately. It would be most interesting to prove or disprove this suggestion. The N. equatorial belt was much disturbed in 1893 and 1894, while the S. was comparatively quiet. Now they are equal in activity. The apparent casting off of matter from the N. edge of this belt is still its most striking feature whether in lines in contact with N. temperate band or dark spots on the N. edge. Over a dozen light and dark spots have been seen at one time on this edge of the belt and some curious rifts have been observed almost at right angles to the belt. In addition the N. tropical zone has exhibited broken lines of dark matter apparently evolved from the zone itself, and suggesting the formation of an additional belt.

The S. tropical zone has had several white spots on it of less striking character than during the last apparition.

The N. and S. temperate bands have not exhibited any remarkable features. There have been occasional thickenings of the S. band and some disturbance of its edges, the N. temperate band has shown a greenish tint, not noticed a few years ago, when the band was abnormally active. Dark and light spots have been seen on this band and the edges have been slightly serrated. But its most



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marked characteristic was its deviation from parallelism with the equator, a rare feature in any belt.

The N.N. and S.S. temperate bands have been frequently seen, but no marked features are noted except an occasional broken appearance.

The Polar regions have frequently been seen ringed and a large dark marking has been seen enveloping the whole N. Pole.

Attention is requested to these portions of Jupiter. Diligent observation may be rewarded here as elsewhere, although the curvature of the globe foreshortens details to so great an extent.

Before concluding this Report, the Director would wish to express his pleasure at the wholly unexpected reception of Dr. Roberts' classical work on "Nebulæ and Star Clusters," as a token of the Section's appreciation of his efforts to serve them. The Director feels he is still more at one with them in Jovian research and observation by this act of considerate kindness on their part. It was a red letter day when the volume came into his possession, and if it bear fruit in more diligent mutual work, it will be a pleasing chapter in the history of the Section.

## Distribution of Drawings.

Several of the Members have kindly permitted that a few sample drawings should be sent to enrich the library of the New South Wales Branch. They will be fixed in a separate small album with brief descriptions, and submitted to the Council for approval of the purpose, and forwarded by the Secretaries if its approval be conceded. It is thought that such acts on the part of the Parent Association will cement the alliance, and prove of mutual advantage. The other Branches can, perhaps, be better served by loans of drawings, at least at present. It is purposed to increase the number of these loans by the Jupiter Section during the coming apparition. Members outside the Section have expressed a hope for similar loans, and it is hoped (with the approval of the Council) that some plan may be devised to meet this wish, especially when the applicant is at a distance from the Association Library.



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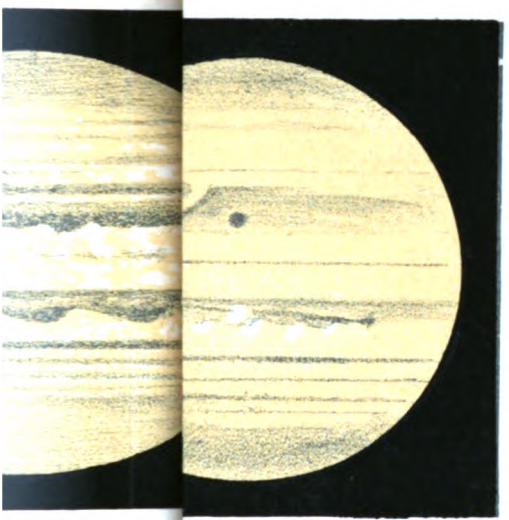

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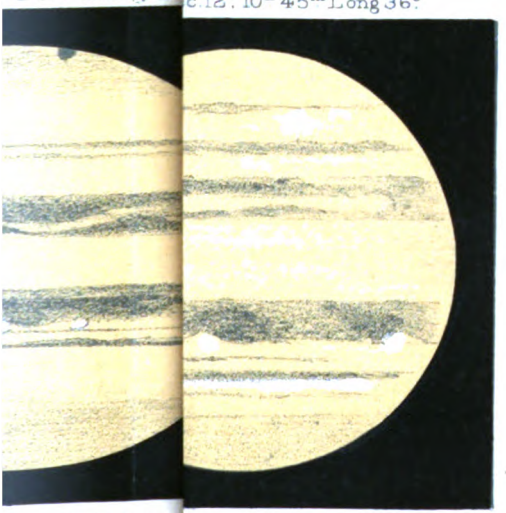
$^{h}35^{m}$ Long. 22 c.12. $10^{h}45^{m}$ Long 36°



rne $8\frac{1}{2}^{in}$ Spec s. $6\frac{1}{2}^{in}$ Spec; Power 100.
$10^{h}$ $45^{m}$ Long h 3. $5^{h}20^{m}$ Long 269°

of sun-spots also, and especial thanks are again due to Prof



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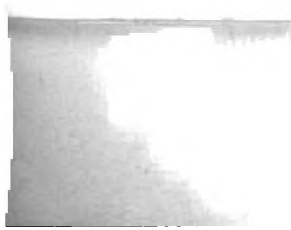

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# SECTION FOR THE OBSERVATION

OF

# THE SUN.

DIRECTOR.—MISS E. BROWN.

## FOURTH REPORT OF THE SECTION, 1894.

### Introduction.

The accompanying report of the Solar section for 1894 will be found to correspond in arrangement with those of previous years, the "Calendar" giving the number of groups visible on each day, and also the most conspicuous faculæ, the "Ledger" their life history and heliographic latitudes and longitudes, which Mr. Maunder has again been good enough to revise. Where only one figure is given it signifies that the mean position of the group only has been entered.

In bulk of material this report almost equals that of 1893, the number of groups amounting as a total to only six less. This proportion, bearing in mind that the numbering of the groups must, to a certain extent, be arbitrary, rather strikingly coincides with the summary of sun-spot observations taken at Zurich, by Dr. A. Wolfe, for the same year, in which he gives the mean observed relative number of spots as 78·0 against 84·9 in 1893.

In this report there are 27 days without any record, only five days more than in 1893, which, it will be remembered, was an exceptionally favourable year for observations; this, considering that our number of regular observers is only eight, seems not unsatisfactory.

The Rev. F. J. Eld and Mr. J. S. Townsend have furnished diagrams of position as before, and Mr. Townsend photographs of sun-spots also, and especial thanks are again due to Prof.



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Pereira for his valuable contributions, which have continued to supply many of the deficiencies so unavoidable in this climate.

Two observers only in the following list, the Rev. W. R. Waugh and Mr. Wykes, use the method of direct vision, the other drawings being all taken by projection. More details on a large scale would be acceptable from Members of the Section.

The illustrations appended have been chosen as exhibiting specimens of a few of the most interesting groups, taken as nearly as possible on the same scale.

Some among them call for particular attention as showing instances of the difference in tint often noticed in the nuclei of large spots, termed by Prof. Pereira "black holes," to which allusion has already been made in the "Journal," Vol IV., p. 300. Such are—

Plate III., Group CX., May 18.
„ VI. „ CXXXVI.
„ VIII. „ CLXXXVI., August 17.
„ VIII. „ CCXIX., October 7.

The luminous bridges are strikingly exemplified in
Plate III., Group CX., May 16.
„ VIII. „ CXIX., October 4 and 7.

NAMES of OBSERVERS from whom drawings, or diagrams, have been regularly received during the year.

| Name. | Address. | Instrument. |
|---|---|---|
| BARTLETT, J. | Bramley | 4-in. O.G. |
| BROWN, MISS E. | Cirencester | 3 and 3½-in. O.G. |
| CORDER, H. | Bridgewater | 6½-in. Spec. |
| ELD, REV. F. J. | Polstead Rectory. | 8½-in. Spec. |
| PEREIRA, J. DE MORAES | Azores | 4½-in. O.G. |
| TOWNSEND, J. S. | Sevenoaks | 4½-in. O.G. |
| WAUGH, REV. W. R. | Portland | 4½-in. O.G. |
| WYKES, J. | Birmingham | 4-in. O.G. |

April 22, 1896.

E. BROWN,
Director of the Section.



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# Calendar of Sun-spots and Faculæ.

## JANUARY 1894.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 | E. 10° to 22° N. One patch bright. W. 7° to 24° S.; 13° to 36° N. |
| 2 | 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 | S.E. extensive. |
| 3 | 4, 5, 6, 7, 8, 10, 11, 15, 16 | N.W. numerous. |
| 4 | 4, 5, 6, 7, 8, 15, 16 | E. 12° to 20° N.; 5° to 20° S. W. 5° to 16° N. |
| 5 | 6, 7, 8, 15, 16 | E. f. group 16.; N.W. |
| 6 | 7, 8, 15, 16, 17, 18, 19 | N.W. numerous. |
| 7 | 15, 16, 17 18 | E. 17° to 30° N. W. 8° to 30° N.; 22° to 34° S. |
| 8 | 15, 16, 17, 18. | |
| 9 | | |
| 10 | 15, 16, 18, 20, 21, 22. | |
| 11 | 15, 16, 18, 20, 21, 22, 23 | E. 0° to 15° S. W. numerous, p. 16. |
| 12 | 15, 16, 18, 20, 21, 22, 24 | E. 7° to 18° N.; 0° to 15° S. W. small, bright, 28° N. 8° to 20° S. |
| 13 | 16, 18, 20, 21, 22, 23, 24, 25 | Some tiny spots not far from centre of disk. |
| 14 | 16, 18, 20, 21, 22, 23, 25, 26 | Three very small spots in Long. 339°, 0° and 4°. Lat. 25°, 16° N., 8° S. |
| 15 | 21, 22, 23, 25, 26, 27, 28 | E. 0° to 20° N.; 0° to 22° S. W. 20° to 35° N.; 12° to 27° S. |
| 16 | 21, 22, 23, 25, 26, 27, 28 | E. 0° to 25° N.; 0° to 22° S. W. 15° to 33° N.; 16° to 29° S. |
| 17 | 21, 22, 23, 25, 26, 27, 28, 29 | N.E. N.W. extending far from limb. |
| 18 | 21, 22, 23, 25, 26, 27, 28, 29, 29A, 29B. | |
| 19 | 21, 22, 23, 25, 26, 27, 28, 29, 29A | E. 17° to 25° N.; 5° to 23° and 30° to 45° S. W. 18° to 30° N.; 18° to 27° S. |
| 20 | 21, 22, 23, 25, 26, 27, 28, 29, 29A, 30, 31 | E., N., and S. Some distance from |
| 21 | 22, 23, 25, 26, 27, 28, 29, 29A, 30, 31. | limb and equator. |
| 22 | | |
| 23 | 25, 26, 27, 28, 29, 30, 31, 32, 33 | E. 15° to 25° N.; 0° to 17° S. W. 0° to 12° N.; 15° to 20° S. |
| 24 | 26, 27, 28, 29, 30, 31, 32, 33, 34, 35 | E. 10° to 22° N.; 8° to 17° S. W. 0° to 10° N. |
| 25 | 26, 27, 28, 29, 30, 32, 33, 34, 35, 36, 37 | N.E. f. group 36. |
| 26 | 26, 27, 28, 29, 30, 32, 33, 34, 35, 36, 37 | E. 25° to 35° N.; 13° to 23° S. |
| 27 | 29, 33, 34, 35, 36, 37 | N.E. near limb. W. numerous N. and S. and N. of three small spots not numbered. |
| 28 | 29, 33, 34, 35, 36 | E. 20° to 33° N.; 10° to 20° S. W. 20° to 30° N.; 0° to 30° S. |
| 29 | 33, 34, 35, 36, 38, 39 | E. very extensive. W. p. groups 33 and 34. |
| 30 | 33, 34, 35, 36, 38, 39 | E. 20° to 35° N.; 5° to 22° S.W. Three patches conspicuous, 8° to 30° N. |
| 31 | 33, 35, 36, 38, 39 | E. f. 28, N.E. f., a small spot not numbered. S.W. bright near limb in two places. |



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## FEBRUARY 1894.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1 | 33, 35, 36, 38, 39, 40 | E. 26° to 35° N.; 10° to 20° S. W. 6° to 30° N.; 6° to 20° S. |
| 2 | | |
| 3 | 35, 38, 39, 40, 41 | E. 10° to 33° N.; 0° to 15° S. |
| 4 | 35, 38, 39, 40, 41 | E. 14° S. and 20° to 25° S. W. 12° to 25° N.: 9° to 16° S. |
| 5 | 38, 39, 40, 41, 42, 43 | E. a patch near equator. A small black dot, in Long. 136°, Lat. 3° N. |
| 6 | | |
| 7 | 38, 39, 41, 42, 43, 44. | |
| 8 | 38, 39, 41, 42, 43, 44, 45. 46, 47 | E. 8° to 20° N.; 5° to 15° S. W. 7° to 30° N. |
| 9 | 39, 41, 42, 43, 44, 45, 46, 47, 50. | |
| 10 | 39, 42, 43, 44, 45 46, 47, 48, 49, 50, 51. | |
| 11 | 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 53 | E. S. of Group 49. W. a patch not near limb (position of 39). |
| 12 | 42, 43, 44, 46, 47, 48, 49, 51, 53 | E. between 48 and 49. W. numerous, region of 42. |
| 13 | 42, 43, 46, 47, 48, 49, 51, 52, 53 | E. on a line with 48; p. 52 patch near limb. W. p. 43, far from limb. |
| 14 | 43, 46, 48, 49, 51, 53 | E. 0° to 30° S. W. 10° to 35° N.; 0° to 10° S., far from limb. Three dots widely separated s. p. 53. |
| 15 | | |
| 16 | 43, 46, 48, 49, 53, 54, 55, 56 | E. N. of 56. W. p. 46. |
| 17 | 46, 48, 49, 53, 54, 55, 56, 57. | |
| 18 | 46, 48, 49, 53, 54, 55, 56, 57 | E. 2° to 25° N. great extent. W. 0° to 40° S. |
| 19 | 48, 49, 54, 55, 56, 57, 58, 59 | E. far N. of 58. W. 0° to 16° N. |
| 20 | 48, 49, 54, 55, 56, 57, 58, 59, 60 | E. 0° to 15° N. 5° to 35° S. W. 10° to 25° N. |
| 21 | 48, 49, 54, 55, 56, 57, 58, 59. 60, 61 | E. 0° to 30° N.; 0° to 35° S.; f. 57, 58, 59. W. between 49 and 60. |
| 22 | 49, 54, 55, 56, 57, 58, 59, 60, 61 | Following 58 far from limb; f. 59, near limb, conspicuous. |
| 23 | 55, 56, 57, 58, 59, 61 | E. 0° to 3° N.; 0° to 21° S. W. 0° to 22° N.; 0° to 18° (unbroken). |
| 24 | 55, 56, 57, 58, 59, 61 | E. 10° to 20° N.; 10° to 25° S. W. 10° to 15° N.; 0° to 23° S. |
| 25 | | |
| 26 | 56, 57, 58, 59, 61, 62. | |
| 27 | 56, 57, 58, 59, 61, 62, 63 | E. 10° to 25° S. W. 5° to 25° N. |
| 28 | 56, 57, 59, 61, 62, 63. | |



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## MARCH 1894.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1 | | |
| 2 | 57, 59, 62, 63, 64 | E. 18° to 30° S. W. 0° to 13° N., and a patch 30° N. |
| 3 | 57, 62, 64 | E. 5° to 20° N.; 5° to 15° S. W. 18° to 35° N.; 8° to 20° S. |
| 4 | 62, 64, 65, 66 | E. 8° to 28° N.; 0° to 30° S. W. 5° to 12° N.; 16° to 28° S. |
| 5 | 64, 65, 66, 67 | E. n. f. group 65, s. f. 67. S.W. region of 62. |
| 6 | 64, 65, 66, 67 | E. n. f. 65, s. f. 67. W. bright far N. and about 26° S. |
| 7 | 65, 66, 67, 68, 69, 70 | E. s. f. 70 and 69. W. same as on the 6th. Three dots in Long. 332°, Lat. 5° S. |
| 8 | 65, 67, 68, 70 | W. extensive to the S., a bright patch about 8° N. |
| 9 | | |
| 10 | 65, 67, 69A, 69B, 70, 71, 72 | E. bright 13° to 16° S. |
| 11 | 65, 67, 69A, 69B, 70, 71, 72 | W. a patch near the equator. |
| 12 | 65, 67, 69A, 69B, 70, 71, 72 | E. numerous s. f. 71. |
| 13 | 67, 69A, 69B, 70, 71, 72, 73, 74 | W. p. 73. |
| 14 | 67, 69B, 70, 71, 72, 74 | E. 15° to 28° S. W. 5° to 30° N.; 3° to 20° S. |
| 15 | 67, 69B, 70, 71, 72, 74. | |
| 16 | 67, 69B, 70, 71, 72, 74 | E. 25° to 38° N.; 7° to 14° S. W. 6° to 27° N.; 0° to 22° S. |
| 17 | 70, 71, 72, 75 | E. 15° to 30° N.; 0° to 40° S. W. 0° to 30° N. |
| 18 | 70, 71, 72, 75 | E. 10° to 20° N.; 10° to 45° S. W. 8° to 24° N. |
| 19 | 71, 72, 75, 75A, 75B | A small spot near centre not numbered. Long. 202°, Lat. 22° S. |
| 20 | 71, 72, 75, 75A, 76. | |
| 21 | 71, 75A, 76, 76A | E. 10° to 30° S. W. 10° to 25° N. |
| 22 | 75A, 76, 76A | E. 3° to 27° S. |
| 23 | 75A, 76, 76A, 77 | Very little on either limb. A small spot in Long. 170°, Lat. 13° S. |
| 24 | 75A, 76, 77, 78 | E. 12° to 30° N.; 12° to 25° S. |
| 25 | 76, 78 | E. 7° to 22° N.; 7° to 25° S. W. 12° to 27° N. |
| 26 | 76, 78, 78A, 79 | E. 2° to 22° N.; 16° to 30° S. W. 26° to 40° N. |
| 27 | 76, 79, 80, 80A, 81 | E. 5° to 18° N.; 15° to 30° S. |
| 28 | 76, 79, 80, 80A, 81, 82, 82A | E. 15° to 28° N.; 18° to 30° S. W. 2° to 25° S. |
| 29 | 76, 79, 80, 80A, 81, 82, 82A | E. 10° to 30° N. W. 0° to 20° N.; 0° to 25° S. |
| 30 | 76, 79, 80, 80A, 81, 82, 82A | E. 10° to 28° N.; 0° to 12° S. W. 6° to 40° N.; 0° to 22° S. |
| 31 | 76, 79, 80, 81, 82, 83 | E. 12° to 22° N.; 6° to 28° S. W. 0° to 30° N.<br>On the 30th a pair of very small spots and dots. Long. 145°, Lat. 14° S.<br>On the 31st a few very small spots. Long. 80°, Lat. 15° S. |



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## APRIL 1894.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1 | 79, 81, 82, 83, 84 | E. 0° to 25° S. W. 20° to 40° N. |
| 2 | 79, 81, 82, 83, 85 | E. 5° to 30° S. W. 8° to 35° N. Small pair of spots, Long. 14°, Lat. 5° S. |
| 3 | 79, 81, 82, 83, 85 | E. 12° to 23° N.; 7° to 35° S. W. 17° to 32° N. |
| 4 | 79, 81, 82, 83, 85, 86. | |
| 5 | 79, 81, 81A, 82, 83, 85, 86 | E. 17° to 23° N. W. 3° to 20° N. A dot, Long. 30°, Lat. 24° S. Two little spots, Long. 313°, Lat. 9° S. |
| 6 | 79, 81, 81A, 82, 83, 86, 87. | |
| 7 | 81, 81A, 82, 83, 85, 86, 87 | W. 15° to 23° S. |
| 8 | 81, 82, 83, 85, 86, 87, 88 | E. 10° to 25° S. W. 20° to 32° S. |
| 9 | 83, 85, 86, 87, 88 | E. 20° to 33° S. |
| 10 | 83, 85, 86, 87, 88 | E. 20° to 34° S. W. 15° to 23° N. |
| 11 | 83, 86, 87 | E. 15° to 30° S. W. 11° to 25° N.; 14° to 30° S. |
| 12 | 83, 86, 89 | E. 10° to 27° S. W. 7° to 18° N.; 12° to 25° S. |
| 13 | 86, 89 | E. 10° to 25° S. W. 12° to 30° N. |
| 14 | 86, 89, 90, 91 | A dot among faculæ, Long 163°, Lat. 13° N. |
| 15 | 86, 89, 90, 91 | E. 7° to 25° N.; 0° to 25° S. |
| 16 | | |
| 17 | 89, 90, 91 | E. 7° to 25° N.; 27° to 38° S. W. 15° to 22° N. |
| 18 | 89, 90, 91 | E. 7° to 20° N.; 27° to 38° S. W. 15° to 23° N. |
| 19 | 89, 90, 91, 92. | |
| 20 | 89, 90, 91, 92. | |
| 21 | 89, 90, 92 | E. 14° to 30° N. W. 10° to 25° N. |
| 22 | 89, 90, 92, 93, 94, 95, 96. | |
| 23 | 89, 90, 92, 93, 94, 95, 96 | E. 9 to 28° S. W. 0° to 28° N. |
| 24 | 89, 90, 92, 93, 94, 95, 96 | E. 10° to 38° N.; 18° to 32° S. W. 5° to 23° N.; 10° to 25° S. A small spot with dots, Long. 74°, Lat. 13° N.; also on the 25th. |
| 25 | 89, 90, 92, 93, 94, 95, 96, 97 | E. 7° to 30° N.; 20° to 33° S. W. 0° to 20° S. |
| 26 | 90, 92, 93, 94, 95, 96, 97, 98 | A cluster of faculæ between 96 and 97. |
| 27 | 90, 92, 93, 94, 96, 97, 98 | A few small spots, Long. 168°, Lat. 7° N., seen also on the 28th. A dot, Long. 358°, Lat. 7° S. |
| 28 | 92, 93, 95, 96, 97, 98 | F. group 98. |
| 29 | 92, 93, 95, 96, 97, 98 | E. 0° to 40°. W. 10° to 25° N. |
| 30 | 92, 93, 95, 96, 97, 98 | A pair of small spots and dots to the N. of them, Long 145°, Lat. 14° S. |



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## MAY 1894.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1 | 92, 93, 95, 96, 97, 98, 99, 100, 101 | E. 10° to 23° N. W. 15° to 37° S. |
| 2 | 95, 97, 98, 99, 100, 101, 102 | E. 7° to 31° N. W. 15° to 30° N.; 14° to 30° S. |
| 3 | 95, 97, 98, 99, 100, 101. | |
| 4 | 95, 97, 98, 99, 100, 103, 104 | E. 13° to 30° N. W. 10° to 35° N. |
| 5 | 98, 99, 101, 103, 104, 105 | W. 10° to 35° N. |
| 6 | 98, 99, 101, 103, 104 | W. 15° to 4° S. |
| 7 | 98, 101, 103, 104, 105. | |
| 8 | 98, 101, 104, 105 | S.E. small but conspicuous. |
| 9 | | |
| 10 | 101, 105, 106, 107, 108, 109. | |
| 11 | | |
| 12 | 101, 109, 110, 111, 113. | |
| 13 | 109, 110, 111, 113 | W. 7° to 32° N. A few to the S. |
| 14 | 109, 110, 111, 112, 113, 114 | E. 12° to 25° S. W. 12° to 24° N. |
| 15 | 109, 110, 113, 114 | E. 14° to 21° S. W. 17° to 23° N. A dot in long. 255°, lat. 11° S. |
| 16 | 109, 110, 113, 114, 115 | A few near S.E. limb, and S.W. limb. |
| 17 | | |
| 18 | 109, 110, 111, 113, 114, 115, 116, 117, 118, 119, 120. | |
| 19 | 110, 111, 113, 114, 115, 116, 118, 119, 120. | |
| 20 | 110, 113, 115, 118, 119, 120 | N.E. |
| 21 | 110, 113, 115, 118, 119, 120 | E. 20° to 30° N. extending 30° from limb. |
| 22 | 110, 113, 115, 118, 119, 120, 121 | S.E. conspicuous. |
| 23 | | |
| 24 | 113, 115, 118, 119, 120, 121, 122 | E. about 20° N., large but faint. |
| 25 | 115, 118, 119, 120, 121, 122 | E. numerous, 20° to 30° S. W. conspicuous round 115. |
| 26 | 115, 119, 120, 121, 122, 123 | E. to the S. still numerous. |
| 27 | 119, 120, 121, 122, 123, 124. | |
| 28 | 119, 120, 121, 122, 123, 125. | |
| 29 | 119, 120, 121, 122, 123, 125. | |
| 30 | 120, 121, 122, 123, 125, 126. | |
| 31 | 120, 121, 122, 123, 125, 126, 127, 128. | |



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## JUNE 1894.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1 | 121, 122, 123, 125, 126, 127, 128. | |
| 2 | 122, 123, 124, 125, 126, 127, 128, 129, 130 | E. a patch just N. of equator, with black dots some distance from limb. W. in three places N. |
| 3 | 122, 123, 124, 125, 126, 127, 128, 129, 130, 131. | |
| 4 | 122, 123, 126, 129, 129, 130, 131, 132 - | E. numerous. W. N. of 122 and far to the S. |
| 5 | 123, 128, 129, 130, 131, 132, 133 - - | W. near limb p. 123, and far to the S. |
| 6 | 123, 128, 130, 131, 132, 133, 134 - - | E. region of 132 and 133 numerous. W. extensive to the S. |
| 7 | 123, 128, 130, 131, 132, 133, 134 - - | E. extensive round and f. 134. |
| 8 | 128, 130, 131, 132, 133, 134, 135. | |
| 9 | 128, 130, 131, 132, 133, 134, 135, 136 - | Numerous f. the groups near E. limb and p. those near W. limb.. |
| 10 | 128, 130, 131, 132, 133, 134, 135, 136, 137. | |
| 11 | 132, 133, 134, 135, 136, 137 - - | E. 8° to 30° S. |
| 12 | 131, 133, 134, 135, 136, 137, 138. | |
| 13 | 131, 133, 134, 135, 136, 137, 138, 139, 140, 141. | E. a broad patch half way between 138 and limb. W. p. 131. |
| 14 | 131, 133, 134, 135, 136, 137, 138, 139, 140, 141. | E. 4° to 15° N.; 3° to 25° S. W. p. 133 and 131. |
| 15 | 131, 133, 134, 135, 136, 137, 138, 139, 140, 141. | E. 0° to 30° S. W. 0° to 14° N.; 0° to 5° S. |
| 16 | 134, 136, 137, 138, 139, 140, 141, 142 - | E. a patch f. 141. Near limb. W. 0° to 12° N. Numerous 10° to 35° S. |
| 17 | 136, 137, 138, 139, 141, 142, 143 - - | E. on a line with 141. |
| 18 | 136, 137, 138, 141, 143, 144 - - | E. 20° to 34° N. W. 0° to 14° N.; 0° to 25° S. |
| 19 | 136, 137, 138, 141, 143, 144 - - | E. numerous N. and S. |
| 20 | 137, 138, 141, 143, 144, 145, 146. | |
| 21 | 137, 138, 141, 143, 144, 145, 146 - - | E. 0° to 21° N.; 0° to 10° S. W. 0° to 15° N.; 0° to 2° and 10° to 25° S. |
| 22 | 137, 138, 141, 143, 144, 145, 146 - - | E. still conspicuous to the S. |
| 23 | 138, 141, 144, 145, 146, 147 - - | W. 0° to 13° N.; 18° to 28° S. |
| 24 | 141, 145, 146, 147, 148 - - - | E. 5° to 25° N.; 5° to 14° S. W. 12° to 23° S. |
| 25 | 141, 145, 146, 147, 148, 149 - - | E. 5° to 14° N. W. 12° to 23° S. Numerous. |
| 26 | 141, 145, 146, 147, 148, 149 - - | E. one bright patch on a line with 148, where 151 afterwards appeared. |
| 27 | 145, 146, 147, 148, 149 - - - | E. 10° to 23° N. W. 15° to 32° S. |
| 28 | 145, 146, 147, 148, 150, 151 - - | E. 0° to 5° N. The bright patch still visible. W. 5° to 35° N.; 10° to 22° S. |
| 29 | 145, 146, 147, 148, 150, 151, 152 - | E. 0° to 6° N.; 0° to 5° S. W. 0° to 12° N. |
| 30 | 145, 146, 147, 148, 150, 151, 152 - - | E. 14° to 24 N.; 5° to 16° S. W. 20° to 33° S. |



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## JULY 1894.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1 | 145, 146, 147, 150, 151, 152, 153 | E. 0° to 15° S. Conspicuous some distance from limb, W. 25° to 36° S. |
| 2 | 147, 150, 151, 152, 153, 154, 155, 156 | E. f. 153, s. p. 153. W. s. p. 150. N. region of 145. |
| 3 | 147, 152, 153, 154, 155, 156, 157. | |
| 4 | 152, 153, 154, 155, 156, 157 | E. 7° to 32° S. W. 0° to 25° N.; 22° to 25° S. |
| 5 | 152, 153, 154, 155, 156, 157 | E. 25° to 35° N.; 10° to 35° S. and 0° to 18° S. |
| 6 | 152, 153, 154, 155, 156, 157, 158, 159, 160 | E. 0° to 14° N.; 0° to 40° S. |
| 7 | 153, 154, 155, 156, 157, 159, 160, 161 | E. 0° to 5° and 14° to 28° S. W. 3° to 15° S. |
| 8 | 153, 154, 155, 156, 157, 159, 160, 161 | E. 0° to 18° N. W. 0° to 7° N. Some distance from limb, 0° to 12° S. |
| 9 | 153, 155, 156, 157, 159, 160, 161, 162 | E. 0° to 17° N.; 8° to 40° S. W. 0° to 5° N.; 0° to 6° S. |
| 10 | 153, 155, 156, 157, 159, 160, 161, 162, 165, 166. | |
| 11 | 155, 156, 157, 159, 160, 161, 162, 163, 164, 165, 166. | N.E., with one small spot. N.W., extensive near limb. |
| 12 | 156, 157, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168. | E. n. p. Group 168. W. p. 156 and s. of 159. |
| 13 | 156, 157, 160, 161, 163, 164, 165, 166, 167, 168, 169. | E. s. of 169. W. many n. p. 157. |
| 14 | 156, 157, 160, 161, 163, 164, 165, 166, 167, 168, 169. | E. many, region of 169. W. s. p. 157. |
| 15 | | |
| 16 | 160, 161, 163, 165, 166, 167, 168, 169, 169A, 170. | E. region of 169A. W. p. 160. |
| 17 | 160, 161, 163, 166, 167, 168, 169, 169A, 170. | E. far N. Faint f. 169A. |
| 18 | 160, 161, 166, 167, 168, 169, 170, 171. | |
| 19 | 161, 166, 167, 168, 169, 170, 171. | |
| 20 | 166, 167, 168, 169, 170, 171, 172 | E. numerous 10° to 25° N. and far S. W. s. p. 166. |
| 21 | 166, 167, 168, 169, 170, 171, 172, 173 | E. s. of 172. W. s. p. 166. |
| 22 | 166, 168, 169, 170, 171, 172, 173 | E. 8° to 25° N. |
| 23 | 168, 170, 171, 172, 173, 174. | |
| 24 | | |
| 25 | 170, 171, 172, 173, 173A, 174 | E. 5° to 18° N. W. 15° to 30° S. |
| 26 | 170, 171, 172, 173, 174. | |
| 27 | 170, 171, 172, 173, 174 | E. 10° to 25° N.; 10° to 20° S. W. 3° to 15° N.; 20° to 30° S. |
| 28 | 170, 171, 172, 173, 174 | E. 5° to 30° N.; 10° to 22° S. W. 5° to 24° N.; 29° to 30° S. |
| 29 | 170, 171, 172, 173, 174, 175, 176 | E. 5° to 18° N.; 12° to 30° S. W. 5° to 18° N.; 25° to 30° S. |
| 30 | 171, 172, 173, 174, 175, 176 | S.E. numerous. W. region of 171, and s. of it. |
| 31 | 172, 173, 174, 175, 176 | E. 0° to 20° N.; 23° to 30° S. W. 10° to 22° N.; 3° to 15° S. |



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## AUGUST 1894.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1 | 173, 174, 175, 176, 177, 181. | |
| 2 | 173, 174, 175, 176, 177, 178, 179, 180, 181 | E. limb extensive, region of Groups 178, 179, 180, 181. |
| 3 | 174, 176, 177, 178, 179, 180, 181 | E. 0° to 22° N.; 0° to 28° S. |
| 4 | 176, 177, 178, 179, 180, 181 | E. 0° to 25° N.; 10° to 25° S. W. 7° to 25° N. |
| 5 | 176, 178, 179, 180, 181 | E. 2° to 18° N. Near 178. |
| 6 | 176, 178, 179, 180, 181. | |
| 7 | 176, 178, 180, 181, 182, 183, 184 | E. 8° to 30° S. W. 8° to 20° N; 10° to 30° S. Some distance from limb. |
| 8 | 176, 178, 180, 181, 182, 183, 184. | |
| 9 | 176, 178, 180, 182, 183, 184 | E. numerous f. 183, and more N. W. Position of 181. |
| 10 | 176, 178, 180, 182, 183, 184 | E. numerous f. groups near limb and N. of them. W. s. p. 180, with three very small spots. |
| 11 | 176, 180, 182, 183, 184 | W. 15° to 35° S. |
| 12 | 178, 180, 182, 183, 184 | E. 0° to 10° N.; 0° to 5° S. W. 0° to 15° N.; 7° to 35° S. |
| 13 | 178, 180, 182, 183, 185, 186 | E. 0° to 18° N. W. 7° to 20° N.; 8° to 26° S. |
| 14 | 180, 182, 183, 185, 186 | E. 9° to 12° N.; 30° to 40 S. W. 0° to 18° N.; 10° to 22° S. |
| 15 | 182, 183, 185A, 186, 187, 188 | E. 0° to 22° N,; 20° to 30° S. W. 0° to 18° N. |
| 16 | 182, 183, 185A, 186, 187, 188, 189 | E. 15° to 23° N.; 8° to 30° S. |
| 17 | 182, 183, 186, 187, 188, 189, 190, 191. | |
| 18 | 182, 183, 186, 187, 188, 189, 190, 191 | E. 10° to 33° N.; 8° to 23° S. region of 189. W. 10° to 30° S. |
| 19 | 183, 186, 187, 188, 190, 191 | E. p. Group 189 and 191. W. 10° to 15° N. |
| 20 | 186, 187, 188, 190, 191, 192 | E. 16° to 23° N. W. 10° to 30° S. a round patch p. 186. |
| 21 | 186, 187, 188, 190, 191, 192 | E. 15° to 25° N.; 23° to 34° S. W. 0° to 10° N.; 0° to 5° S. and 10° to 23°, |
| 22 | 186, 187, 188, 190, 191, 192 | E. 16° to 30° N. W. 0° to 11° N.; 0° to 5° S. and 30° to 40° S. |
| 23 | 188, 190. | |
| 24 | | |
| 25 | 190 | E. extensive p. 195, s. f. 194. W. s. p. 193, and patches to the S., one very far S. |
| 26 | 193, 194, 195 | E. 0° to 18° N. far from limb. 0° to 3° S. and 20° to 30°. W. 7° to 17° S. |
| 27 | 193, 194, 195. | |
| 28 | 193, 194, 195 | E. f. 195 considerable, 20° or more S. W. 10° to 20° S. |
| 29 | 194, 195 | E. 0° to 11° N. round patch f. 195. W 17° to 30° S. and 35° to 40°. |
| 30 | 194, 195, 196 | E. 5° to 23° N.; 11° to 35° S. W. 15° to 30° N.; 0° to 10° S. |
| 31 | 194, 195, 196 | E. widespread 5° to 25° N.; 10° to 27° S., one small and bright patch near limb, with pair of small spots. W. 10° to 25° N. |



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## SEPTEMBER 1894.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1 | 194, 195 | E. The bright patch of Aug. 31 still visible, another more S. |
| 2 | 194, 195 | E. 10° to 15° and 30° S. Round a veiled spot. Long. 160°. Lat. 27° S. A small spot in Long. 137°, Lat. 12° S. |
| 3 | | |
| 4 | 194, 195 | W. to the N., and far S. some distance from limb. |
| 5 | 195, 197, 198, 199 | N.W. extensive p. Group 195. |
| 6 | 195, 197, 198, 199, 200, 201, 202, 203 | E. 0° to 25° N.; 8° to 18° S. W. 0° to 20° N. |
| 7 | 195, 197, 198, 199, 201, 202, 203, 204, 205 | Region of 195, numerous. |
| 8 | 197, 198, 199, 201, 201A, 202, 203, 204, 205, 206, 207. | W. extensive far S. |
| 9 | 197, 199, 201, 201A, 202, 203, 204, 205, 206, 207, 208. | W. same position? |
| 10 | 197, 199, 201, 201A, 202, 203, 204, 205, 207, 208. | E. 2° to 25° N.; 18° to 30° S. W. 10° to 33° S. |
| 11 | 199, 201, 201A, 202, 203, 204, 207, 208, 209. | E. 6° to 16° S.; W. 0° to 12° N.; 12° to 33° S. |
| 12 | 199, 201, 201A, 202, 203, 207, 209. | |
| 13 | 199, 201, 201A, 202, 203, 207, 209, 210, 211. | F. Group 209. |
| 14 | 201, 201A, 202, 203, 209, 210, 211 | E. 0° to 6°, and 12° to 28° N.; 0° to 12°, and 33° to 40° S. W. 25° to 35° N.; 10° to 25° S. |
| 15 | 201, 202, 209, 211, 212 | E. many f. and s. of 209. W. near limb far N. |
| 16 | 201, 202, 209, 211. | |
| 17 | 201, 202, 209, 211 | W. f. and s. of 201, as far as equator. |
| 18 | 201, 202, 209, 211 | N.W. as on the 17th, and S.W. region of 202. |
| 19 | 211, 213 | E. 15° to 24° N. W. 12° to 28° S. |
| 20 | 211, 213 | W. Two bright patches far from limb. |
| 21 | 211, 213, 213A | E. many f. 213, p. 213A; S.W. far from limb. |
| 22 | 211, 213, 213A, 214. | |
| 23 | 211, 213, 213A, 214 | E. very extensive, 0° to 20° N. |
| 24 | 211, 213, 213A, 214 | N.E. far from limb. |
| 25 | 211, 213, 213A, 214 | N.E. same position, S.E. near limb. |
| 26 | 213, 214 | E. extensive, N. and S. |
| 27 | 213, 215, 216 | E. 8° to 25° N.; 15° to 22° S. |
| 28 | 213, 215, 216 | E. 5° to 14° N.; 12° to 21° S. |
| 29 | 213, 215, 216, 217 | E. 6° to 20° N.; 10° to 23° S. W. 7° to 23° N.; 20° to 26° S. |
| 30 | 213, 216, 217, 217A, 218 | E. 8° to 30° S.; 0° to 22° N. |



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## OCTOBER 1894.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1 | 215, 216, 217, 217A, 218 | W. extensive to the N. and S. |
| 2 | 215, 217, 217A, 219, 219, 220 | E. 3° to 15° N.; 0° to 22° S. W. 0° to 25° N.; 18° to 30° S. |
| 3 | 215, 217, 217A, 218, 219, 220, 221 | S.W. numerous. |
| 4 | 215, 217, 217A, 218, 219, 220, 221 | E. f. groups 219, 221. W. region of 218. 20° S. far from limb. |
| 5 | 215, 217, 217A, 219, 220, 221. | |
| 6 | | |
| 7 | 215, 217A, 219, 220, 221, 222 | W. 10° to 15° S. |
| 8 | 215, 217A, 219, 220, 221, 222 | S.W. conspicuous p. 217A. |
| 9 | 215, 219, 220, 221, 223 | E. near equator. S.W. position of 217A. |
| 10 | 219, 220, 221, 222, 223 | N.E. and f. 223. S.W. numerous. |
| 11 | | |
| 12 | 219, 221, 221, 222, 223, 224, 225 | E. near equator. |
| 13 | 219, 220, 221, 222, 223, 224, 225 | E. 3° S. W. numerous region of 219. |
| 14 | 219, 220, 221, 222, 223, 224, 225 | E. N. and S. |
| 15 | 221, 222, 223, 225 | N.E. near limb. W. p. 225, n.f. 221. |
| 16 | 222, 223, 225 | N.E. A patch considerably to the S. |
| 17 | 226 | E. near limb. |
| 18 | 226, 227 | E. n. of 226. W. 5° and 14° S. |
| 19 | 226, 227, 228, 229. | |
| 20 | 226, 228, 229 | E. f. 228 and 229. |
| 21 | 226, 228, 229 | E. round 229. W. region of two very small spots, one N., one S. Some distance from limb, not numbered. |
| 22 | 226, 228, 229, 230, 231 | W. near limb, N. and S. |
| 23 | | |
| 24 | 226, 228, 229, 230, 231, 232, 233 | E. on a line with 233. Near limb, two distinct patches more N. |
| 25 | 229, 230, 231, 233, 234 | S.E. conspicuous f. and s. of 234, also N.E. |
| 26 | 229, 230, 231, 233, 234 | S.E. f. 234, numerous. |
| 27 | 229, 230, 231, 234 | S.E. |
| 28 | 229, 230, 235, 236, 237 | N.E. Small patch far from limb, and 3° to 13° S. Position of train. |
| 29 | 229, 235, 236, 237, 233, 239 | E. 3° to 17° S. N.W. numerous, and S. of 229. |
| 30 | | |
| 31 | | |



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## NOVEMBER 1895.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1 | 236, 237, 240 | E. 2° to 17° N.; 14° to 30° S. f. Group 237 to limb. W. numerous N. and S. |
| 2 | 236, 237, 241, 242 | E. extensive to the N. |
| 3 | 236, 237, 241, 242 | N.E. and S.E. f. 242, N.W. |
| 4 | 236, 237, 241, 242 | E. 5° to 33° S. W. 7° to 25° N.; 5° to 23° S. |
| 5 | 236, 237, 241, 242 | E. f. 242. W. to to the N. and S. |
| 6 | 236, 241, 242, 243 | E. 9° to 18° S. W. 13° to 33° S. |
| 7 | | |
| 8 | 236, 241, 242, 243, 244 | E. 10° to 20° N. faint. W. 5° to 18° S. |
| 9 | 241, 242, 243, 244 | E. to the N. and far S. of 244. W. conspicuous to the S. |
| 10 | 241, 242, 243, 244, 245, 247 | E. far S. faint. W. 0° to 15° N.; 5° to 35° S. |
| 11 | 242, 243, 244, 245, 246 | E. near limb, sweeping to the S. W. 0° to 25° N.; 0° to 34° S. |
| 12 | 242, 243, 244, 245, 246 | E. bright patches to the S. W. s. f. 242. |
| 13 | 243, 244, 245, 246, 247 | E. 7° to 25° N. W. 0° to 34° S. far from limb. |
| 14 | 243, 245, 246, 247, 248. | |
| 15 | 245, 246, 247, 248 | E. a patch far from limb N. 0° to 12° S. W. 3° to 12° S. and 18° to 28°. |
| 16 | 245, 246, 247, 249. | |
| 17 | 246, 247, 248, 249 | E. 13° to 35° N. W. 10° to 25° N. |
| 18 | 247, 248, 249, 250 | E. 0° to 22° S. W. 0° to 25° N.; 0° to 25° S. |
| 19 | 247, 248, 249, 250, 251, 252 | E. 0° to 22° S. W. on a line with 247. |
| 20 | 247, 248, 249, 251, 252 | E. 2° to 18° N. |
| 21 | 247, 248, 249, 251, 252, 253 | E. 0° to 17° N.; 5° to 20° S. far from limb. W. 18° to 20° S. One or two very small spots. Long. 228°. Lat. 20° S. |
| 22 | 248, 249, 251, 253. | |
| 23 | 248, 249, 251, 253, 255 | E. conspicuous from equator southwards. A patch p. 249 N.W. |
| 24 | 249, 251, 253, 254, 255 | E. 0° to 17° N.; 0° to 16° S. W. 0° to 22° N.; 0° to 5° S. |
| 25 | 249, 251, 253, 254, 255 | E. 8° to 20° N.; 5° to 23° S. W. 0° to 20° N.; 0° to 4° and 8° to 20° S. |
| 26 | | |
| 27 | 251, 253, 255A, 256 | Two very small spots N. f. not numbered. |
| 28 | 251, 255A, 256 | N.E. far from limb and S.E. N.W and near equator S.W. |
| 29 | 251, 255A, 256, 257 | E. p. 257 and 258. W. region of 253. |
| 30 | 253, 255, 256, 257, 258 | E. f. 257. S.W. region of 253. |



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## DECEMBER 1895.

| Day. | Groups of Sun-spots. | Faculæ. |
|---|---|---|
| 1 | 256, 256A, 257, 258, 259 | E. 6° to 22° N.; 3° to 28° S. W. 0° to 20° N.; 8° to 24° S. very extensive. |
| 2 | 256, 256A, 257, 258, 259, 260 | Nearly same position as yesterday. |
| 3 | 256, 256A, 257, 258, 259, 260, 261 | E. 3° to 12° S. and 18° to 28°. W. 2° to 22° S. |
| 4 | 257, 258, 259, 260, 261 | E. 0° to 8° S. W. 2° to 13° S. |
| 5 | 257, 258, 260, 261, 262 | E. region of 261. W. 17° to 25° S. |
| 6 | | |
| 7 | 257, 258, 259, 260, 261, 262. | |
| 8 | 257, 258, 259, 260, 261, 262, 263 | N.E. W. 10° to 30° S. |
| 9 | | |
| 10 | | |
| 11 | 258, 260, 262, 264 | E. 10° to 20° N. W. 5° to 20° N.; 5° to 30° S. |
| 12 | 262, 264 | W. 17° to 27° S. |
| 13 | 262, 264. | |
| 14 | | |
| 15 | 262, 264, 265 | E. 0° to 22° S. W. 0° to 32° S. |
| 16 | 264, 265, 266. | |
| 17 | 265, 266, 267. | |
| 18 | 265, 266, 267 | E. extensive S. of equator. |
| 19 | 265, 266, 267 | E. 7° to 28° N.; 6° to 23° S. W. 10° to 28° N.; 8° to 30° S. |
| 20 | 265, 266, 267, 268 | E. 6° to 10° S. |
| 21 | 265, 266, 268, 269 | E. numerous N. of 268, and f. 269. |
| 22 | 265, 266, 268, 269 | E. region of 268, and far N. of it. |
| 23 | 265, 266, 268, 269, 270 | E. region of 270, and far N. |
| 24 | | |
| 25 | 265, 266, 268, 269, 270, 271. | |
| 26 | | |
| 27 | 266, 268, 270, 271, 272 | E. Numerous S. One very bright patch N., region of 272. |
| 28 | 268, 270, 271, 272, 273, 274 | W.N. and far to the S. |
| 29 | 270, 271, 273, 274, 275 | E. p 274, far from limb. W. small patches far from limb also. |
| 30 | 270, 271, 273, 274. | |
| 31 | 270, 271, 273, 274, 276, 277, 278, 279 | S.W. |



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# Sun-spot Report, 1894.

## LEDGER.

Jan. GROUP 1. *Long.* 254°. *Lat.* 5° N.
1. A small spot near W. limb. (Group 270 of December 1893.)

Jan. GROUP 2. *Long.* 233°. *Lat.* 3° S. (Group 275 of 1893.)
1. A considerable spot near W. limb.

Jan. GROUP 3. *Long.* 228°. *Lat.* 31° S.
1. A penumbral spot near W. limb.

Jan. GROUP 4. *Long.* 200°. *Lat.* 12° S.
1. A normal spot with two nuclei.
2. Little change.
3. Penumbra nearly equal on both sides.
4. Close to W. limb.

Jan. GROUP 5. *Long.* 189°. *Lat.* 13° S.
1. A compound spot, or rather two similar spots, in close proximity, penumbra streaming upwards. Two of the nuclei dense. Much altered since December 30, 1893.
2. Merged into one spot; major axis 1° of arc.
3. Dividing into three or four sections.
4. Sections fewer, two or three conspicuous sharp nuclei, near W. limb.

Jan. GROUP 6. *Long.* 183°. *Lat.* 14° S.
1. A compound spot, following group 5, in two divisions, nuclei small, numerous.
2. Smaller, no division, penumbra gaping in front.
3. More regular, two principal nuclei.
4. Penumbra wanting on the s.p. side.
5. Near W. limb.

Jan. GROUP 7. *Long.* 171°. *Lat.* 8° S.
1. A large spot past the centre of disk, more normal than on December 30, 1893. Nucleus entire, outliers very inconspicuous.
2. Little change. One outlier.
3. Outliers more numerous.
4. Outliers to the N. and S.
5. Penumbra nearly equal on both sides.
6. Very near W. limb at noon.

Jan. GROUP 8. *Long.* 159°. *Lat.* 9° S.
1. A large compound spot, much changed since December 30, 1893 (group 281), when it was almost normal with a pair of large nuclei. Now in process of separation, a train of smaller penumbral spots sweeping round it to the S.
2. In three nearly equal sections. The most p. of the outliers forming one. The f. quite disconnected. The largest of the nuclei, to the N., bridged. Two miniature streams of dots.
3. Still trifid, but less compact, three conspicuous nuclei. The f. outliers smaller but more numerous.
4. Three spots, quite separate, the nucleus of the northerly spider-like, the s. p. horseshoe shaped, the f. double. Outliers decreasing.
5. Northerly spot normal, the other two fast fading.
6. All smaller.



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Jan. GROUP 9. *Long.* 156° to 153°. *Lat.* 15° to 17° N.
1. A few very small spots in two sets.
2. Three, forming a triangle.

Jan. GROUP 10. *Long.* 150°. *Lat.* 18° S.
1. A very small nebulous spot.
2. No change.
3. No change.

Jan. GROUP 11. *Long.* 144°. *Lat.* 10° S.
1. A faint little spot, resembling 10.
2. No change.
3. Two dots in addition.

Jan. GROUP 12. *Long.* 116°. *Lat.* 10° S.
1. A small spot with very slight penumbra.
2. Smaller.
3. More in number.
4. Two very small spots.

Jan. GROUP 13. *Long.* 107°. *Lat.* 8° S.
1. A small, faint spot, resembling 12.
2. A pair.

Jan. GROUP 14. *Long.* 98°. *Lat.* 15° S.
1. Another small, faint spot, resembling 12 and 13.
2. No increase.

Jan. GROUP 15. *Long.* 90° to 82°. *Lat.* 21° to 23° N.
2. A little spot in the midst of faculæ.
3. A stream, the most f. only with penumbra.
4. More extended, almost a zigzag, final spot with double nucleus.
5. More in a line, the final one-sided.
6. The most p. larger than the final; intermediate small, zigzag.
7. Leading spot crescented, final dispersed.
8. Leader decreasing.
10. No details.
11. Two penumbral spots near W. limb.
12. One spot close to W. limb.

Jan. GROUP 16. *Long.* 50°. *Lat.* 14° S.
3. A spot near E. limb, nucleus divided; a smaller spot at some distance p.
4. Normal, nucleus double.
5. Nucleus triple.
6. Penumbra gaping on the f. side; a few outliers p.
7. Almost split in two. Area 1,006 square seconds.
8. Little change.
10. More connected.
11. Just severed; the first a copy in miniature of the large one, having double nuclei and the penumbra on opposite sides.
12. Large spot still a close pair, the two p. pairs fragmentary and widely separated.
13. Pairs further apart.
14. The large spot completely severed. The small pairs dispersed.

Jan. GROUP 17. *Long.* 48° to 44°. *Lat.* 15° to 17° N.
6. A triangular-shaped group of small spots, one penumbral.
7. No details.
8. Spots all very small.



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Jan. GROUP 18. *Long.* 18°. *Lat.* 26° N.

6. A spot near E. limb, penumbra on the p. side; two smaller f.
7. No details.
8. One principal spot.
10. Not seen.
11. Four small spots, one with slight penumbra.
12. Two spots.
13. Little change.
14. One spot.

Jan. GROUP 19. *Long.* 123°. *Lat.* 4° N.

6. A pair of very small spots in the p. hemisphere.

Jan. GROUP 20. *Long.* 338°. *Lat.* 12° S.

10. A few little spots.
11. Small spots and dots in a semicircle.
12. A penumbral spot, nuclei beaded, a few dots and one small spot f.
13. Circular, much dwindled.
14. A pair of small spots and a few dots, followed by two more pairs at equal distances.

Jan. GROUP 21. *Long.* 336°. *Lat.* 2° S.

10. A penumbral spot not far from E. limb (a return spot).
11. Normal.
12. Little change.
13. Circular.
14. Nucleus more uneven. Area 600 square seconds.
15. Normal.
16. Little change.
17. Rather more jagged.
18. Rather decreasing.
19. More tapering to the N.
20. Normal.

Jan. GROUP 22. *Long.* 325° to 318°. *Lat.* 10° to 16° S.

10. A penumbral spot at a little distance from E. limb.
11. A large spot with sharply divided nucleus, followed by a swarm of little dark ones.
12. Nucleus with sharp fissures on the f. side, penumbra drawn out in the same direction and ending in a tiny stream of dots.
14. Much increased, nucleus angular with a great expanse of penumbra eastward, a collection of dark nuclei in place of the dots, many of them wedge-shaped. To the N. a small secondary stream.
15. Further increase and amazing change, the denser nucleus of yesterday shattered into six or seven fragments, the penumbra streaming to the W. as well as to the E., where it now forms two branches, embracing and connecting the little dark nuclei. Closely N. f. is a normal spot with bridged nucleus, length 45″. Secondary stream decreasing.
16. General outline squarer, the normal spot appears to have coalesced with the other portions of the group, but no particulars were obtained.
17. Further change. S. p. are three large nuclei and some narrow fissures. A great extent of penumbra to the N., surrounding what was before the normal spot. The f. portion has also more penumbra, the two branches of the 15th spreading out laterally. Major axis more than 2′ of arc. Area 1,900 square seconds. No secondary stream.
18. One of the three large nuclei serpentine and nodular, the others breaking up, a new one has appeared to the N.
19. Nuclei more equalised. Five of the p. form almost a semicircle. The f. portions are on the wane.
20. Four principal nuclei, the p. portions are becoming more detached.
21. Nearing W. limb.

N.B.—The Longitude was nearly the same as the large equatorial group of November 1893.

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Jan. GROUP 23. *Long.* 310°. *Lat.* 12° N.
11. A large compound spot near E. limb.
12. Normal, many fragments to the S.
13. Penumbra cut off on the f. side.
14. Fragmentary spots increasing. Area of the whole 1,380 square seconds.
15. Nucleus broken up to the E. Some irregular spots f. mixed with dots.
16. New outliers p.
17. Large spot, pear-shaped, a swarm of small outliers surrounding it, one only with penumbra.
18. Forked at the extremity. Outliers to the N.
19. No details.
20. Normal. No outliers observed.
21. Little change.

Jan. GROUP 24. *Long.* 346°. *Lat.* 6° to 8° N.
12. A pair of faint spots some distance apart.
13. Only just visible.

Jan. GROUP 25. *Long.* 284°. *Lat.* 4° N.
13. A spot near E. limb, penumbra on the p. side.
14. Nearly normal, some small irregular spots f.
15. Nucleus double, a tiny pair s. f.
16. Little change.
17. Split in two, many dots n. and s. f.
18. Re-united, three nuclei.
19. Four nuclei; four outliers.
20. Group triangular.
21. One principal spot, penumbra on the s. f. side.
23. Reduced to a very small spot.

Jan. GROUP 26. *Long.* 270° *to* 262°. *Lat.* 15° S.
14. A compound spot near E. limb.
15. Nucleus very large, a patch of penumbra apparently torn off on the f. side, several smaller spots f.
16. F. spots more in number.
17. Normal, 1′ of arc in length, nucleus dense, two lobed; a wide stream of very small spots f.
18. Nucleus bridged, area 1,600 square seconds, f. spots decreasing.
19. Nucleus double.
20. Nucleus curved, outliers fewer.
21. No radical change.
23. Normal.
24. Little change.
25. Near W. limb.
26. Penumbra nearly equal on both sides.

Jan. GROUP 27. *Long.* 260°. *Lat.* 6° S.
14. A normal spot very near E. limb.
15. Penumbra nearly equal.
16. Little change.
17. A stream of dots n. f.
18. Nearly circular. Area 1,000 square seconds.
19. F. spots increasing.
20. Little change.
21. F. spots very small.
23. Circular, no outliers.
24. Little change.
25. No details.
26. Near W. limb.



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Jan. GROUP 28. *Long.* 255°. *Lat.* 2° N.
14. A spot close to E. limb (at $12^h\ 43^m$).
15. Nearly normal. This spot with 26 and 27 were striking objects, being somewhat similar, and stretching at nearly equal distances from the equator N. and S.
16. Little change.
17. Two nuclei.
18. Little change. Area 900 square seconds.
19. One f. spot.
20. Little change.
21. More elongated, nucleus jagged.
22. Nucleus bridged.
24. Nucleus double.
25. Little change.
26. Decreasing.

Jan. GROUP 29. *Long.* 233°. *Lat.* 4° S.
17. A penumbral spot near E. limb; a smaller spot p.
18. Nucleus jagged, penumbra with an arm to the S.
19. Normal.
20. A small spot to the N.
21. Circular, a few dots only surrounding.
23. Nucleus fimbriated; a tiny cluster of dots f. at some distance.
24. Little change.
25. A few outliers.
26. Little change.
27. Nearing W. limb.
28. Decreasing.

Jan. GROUP 29A. *Long.* 298°. *Lat.* 16° S.
18. A few very small spots f. Group 22 at same distance.
19. No increase.
20. Little change.
21. Very few.

Jan. GROUP 29B. *Long.* 282°. *Lat.* 23° S.
18. Two or three very small spots.
19. Much the same.

Jan. GROUP 30. *Long.* 264° to 257°. *Lat.* 15° N.
18. A single dot.
19. Not seen.
20. Four little spots with slight penumbra.
21. Leading spot nearly normal, a stream of small ones f.
23. In a.m. leader with sharply fissured nucleus, the f. very irregular. In the p.m. leader bridged, the f. more united.
24. Details wanting.
25. Leader more entire, the f. decreasing.
26. Both much reduced.

Jan. GROUP 31. *Long.* 202°. *Lat.* 9° S.
20. A little spot with slight penumbra.
21. A few outliers to the S.
23. Still small, but crossed by bridges.
24. No increase.

Jan. GROUP 32. *Long.* 189° to 184°. *Lat.* 16° S.
23. A few small spots.
24. In a cluster.
25. Fewer.
26. One spot.



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Jan. GROUP 33. *Long.* 175°. *Lat.* 6° S.
21. A normal spot near E. limb, a smaller one f.
23. Nucleus cleft and pointed.
24. No details.
25. Almost circular.
26. Half-moon shaped, with small nuclei, major axis about 30″.
27. Again entire, two nuclei.
28. Two small spots f.
29. Little change.
30. Nucleus single, penumbra more on the p. side.
31. Decreasing.
Feb.
1. Little change.

Jan. GROUP 34. *Long* 208° to 199°. *Lat.* 30° S.
24. Two small spots not far from the centre of disk.
25. More in number.
26. A stream, wider at the end.
27. One of the final spots much increased, with many small nuclei.
28. Final spot split in two, nuclei and dots streaming from it. Leader enlarging, but with no penumbra, and singular in form.
29. Spots in two sets, reduced; immersed in faculæ.
30. Hardly distinguishable, faculæ in a long curve.

Jan. GROUP 35. *Long.* 156° to 142°. *Lat.* 10° to 18° N.
23. Three small spots, observed at 4 p.m., but not in the forenoon.
24. Two, with a little penumbra.
25. More numerous, in two sets, N. and S. of each other, penumbra almost entirely absent.
26. Still more numerous, the spots to the N. in a wide stream, as many as 25. Those to the S. in two sets, curved.
27. Some of the N. spots much larger, interspersed with small nuclei and dots. Those to the S. also more developed.
28. Spots to the N. in a narrow curved stream, fewer and smaller.
29. Two irregular spots to the N., followed by a zigzag of very small ones, vertical. Those to the S. also dwindling.
30. Decreasing rapidly, to the N. only four or five.
31. One faint spot to the N. Two, with a few dots, to the S.
Feb.
1. One spot, small but normal.
3. Very small, a fainter one to the S.

Jan. GROUP 36. *Long.* 159°. *Lat.* 9° S.
25. Two small spots f. Group 33.
26. A leading spot, pear-shaped, nucleus forked, length 40″. Small outliers f.
27. Nucleus with a hook at the end, outliers only dots.
28. Nucleus double, dots in a tiny cluster.
29. Light round the nucleus, especially to the N. No outliers seen.
30. Nucleus still with light to the N.
31. Normal, much resembling Group 33.
Feb.
1. Little change.

Jan. GROUP 37. *Long.* 212° to 208°. *Lat.* 11° N.
25. A miniature group, W. of centre of disk.
26. A few tiny spots p., a very small normal spot f.
27. Three dots following each other in a line.

Jan. GROUP 38. *Long.* 83° to 80°. *Lat.* 12° N.
29. Two very small spots in the midst of faculæ near E. limb.
30. One spot.
31. Two, very small.
Feb.
1. Not observed.
3. A triangular group of small spots, two only with slight penumbra.
4. Rather more numerous.



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Jan. GROUP 39. *Long.* 77° to 66°. *Lat.* 16° to 19° S.
29. Two or three very small spots near E. limb.
30. A few more f.
31. About eight in a wide stream.
Feb.
1. A compound spot p., a few small ones f.
3. The p. opening to the E. with fragmentary sputterings, major axis 45″, nucleus double. Another spot f. about 30″, major axis with nuclei in a crescent, many outliers between the two.
4. Nucleus of p. crescented.
5. P. more circular. Nucleus tripartite. At 1.13, Prof. Pereira found that the opening still left had become nearly closed after little over an hour's observation. The f. much elongated, outliers fewer but larger. A pair of small spots at some distance n.f.
7. The p. more normal, nucleus double, f. much diminished.
8. The p. with three nuclei, penumbra splitting to the N. The f. with only a little penumbra to the E. Outliers very few. About five n.f. spots.
9. The p. with two nuclei, penumbra still opening to the N. The f. still dwindling.

Feb. GROUP 40. *Long.* 189°. *Lat.* 3° N.
1. Two small spots past the centre of disk.
3. A cluster.
4. About three near W. limb.
5. One spot much larger. Close to W. limb at 12.48.

Feb. GROUP 41. *Long.* 20°. *Lat.* 15° N.
3. A normal spot.
4. Little change.
5. Almost circular, nucleus fimbriated, area 350 square seconds.
7. No details.
8. Breaking up, nuclei small, penumbra cut off on the p. side, a portion having apparently been detached, nearly central.
9. Fast decreasing.

Feb. GROUP 42. *Long.* 9° to 3°. *Lat.* 15° N.
5. A little train of irregular spots.
7. Two prominent spots.
8. Train curved, three spots with penumbra, the first almost normal, the two last as if one had burst asunder.
9. All much decreased.
10. About three spots.
11. A circular one p., a very small one f.
12. One very small p. and two dots f.
13. A tiny pair near W. limb, many faculæ.

Feb. GROUP 43. *Long* 333°. *Lat.* 10° S.
5. Several spots near E. limb.
7. A penumbral spot followed by smaller ones.
8. A diffuse cluster, two leading spots with penumbra on opposite sides, N. and S., the larger 40″, major axis, the rest hardly larger than dots.
9. More scattered, three penumbral spots, all one-sided.
10. Leaders smaller but more normal, a regular zigzag of dots n.p.
11. One of the leaders much reduced, the other with crescented nucleus, the zigzag is now a stream of almost invisible dots.
12. A fan-shaped spot with a few neighbouring dots.
13. Little change.
14. Penumbra only to the S. Nucleus crescented. One dot near, two at a distance.
16. Three or four very small spots in a line.



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Feb. GROUP 44. *Long.* 323°. *Lat.* 16° S.
7. A small penumbral spot f. Group 43. (Position of Group 22).
8. Normal.
9. Nucleus curved.
10. More elongated, major axis 20″.
11. Nucleus tapering at both ends.
12. Breaking up, much diminished.

Feb. GROUP 45. *Long.* 339°. *Lat.* 18° N.
8. Two little spots, f. each other (n.f. Group 42).

Feb. GROUP 46. *Long.* 306°. *Lat.* 11° N.
8. A normal spot, about two days from E. limb.
9. Nucleus partly curved.
10. Tapering at the end, nucleus dividing; two small penumbral spots f.
11. Normal, nucleus fimbriated, f. spots disjointed.
12. F. spots very small, but more numerous.
13. Nearly circular, f. spots in four sets, nearly equidistant.
14. Nucleus two-lobed, f. spots nearly gone, a few n.p.
16. Nucleus bridged, no outliers.
17. Decreasing.
18. Nucleus divided, apparently breaking up.

Feb. GROUP 47. *Long.* 300°. *Lat.* 4° N.
8. A small spot with slight penumbra, not far from E. limb.
9. No increase.
10. Smaller.
11. Little change.
12. Two or three tiny dots in nearly the same position.
13. One dot.

Feb. GROUP 48. *Long.* 268°. *Lat.* 14° S.
10. A penumbral spot near E. limb.
11. Penumbra nearly equal on the p. and f. side.
12. Two nuclei.
13. Circular.
14. Nuclei beginning to sub-divide.
16. Two nuclei, unequal in size.
17. One nucleus, a small spot f. Area 500 square seconds.
18. Nucleus bridged.
19. Nucleus divided, penumbra also splitting.
20. Little change.
21. In two parts.

Feb. GROUP 49. *Long.* 266°. *Lat.* 17° N.
10. A large spot very near E. limb (at 1 p.m.)
11. Normal.
12. Penumbra nearly equal on both sides.
13. Little change.
14. Nucleus fimbriated. Area 800 square seconds.
16. Little change.
17. Little change.
18. Penumbra wider to the N., a small spot p.
19. Nucleus dividing.
20. Little change.
21. Nucleus entire.
22. Very near W. limb.

Feb. GROUP 50. *Long.* 318°. *Lat.* 23° S.
9. Two extremely small spots f. Group 44.
10. A swarm of small spots.
11. A miniature stream.



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Feb. GROUP 51. *Long.* 346° to 340°. *Lat.* 18° to 23° N.
10. Two little pairs with a few dots widely scattered.
11. A small nebulous spot, dots f. in a line.
12. A few dots widely separated.
13. A very small spot p., a nebulous one and a minute cluster f.
14. Two little pairs.

Feb. GROUP 52. *Long.* 344°. *Lat.* 10° N.
13. Three very small spots S. of group 51.

Feb. GROUP 53. *Long.* 321° to 318°. *Lat.* 6° to 9° S.
11. A semi-circular group of little spots.
12. A cluster, almost entirely composed of dots, 24 at least.
13. A stream, 2′ of arc in length, no increase in area of dots.
14. Fainter, constituents fewer. Three dots s.p., very widely separated.
16. Dwindling.
17. One spot.
18. Near limb.

Feb. GROUP 54. *Long.* 239° to 232°. *Lat.* 12° N.
16. Three spots with a little penumbra.
17. Little altered.
18. A stream, the leader only penumbral, the rest very small. A tiny spot f. at some distance.
19. Leader more normal, tapering, a miniature zigzag of dots, quite distinct.
20. Leader oval, dots almost gone.
21. Much smaller.
22. Still decreasing.

Feb. GROUP 55. *Long.* 202° to 197. *Lat.* 24° to 29 S.
16. A spot near E. limb with curved nucleus and penumbra on the f. side, a small one in advance, apparently once forming part of it.
17. Almost severed, forming three spots.
18. A cluster, somewhat triangular in form, composed of many small sharp nuclei and a fair amount of penumbra with outlying spots and dots.
19. More dispersed, one spot larger than the rest.
20. The largest spot more circular, the rest all small but quite as numerous, some new since yesterday.
21. An immense number of little spots and dots, many of them angular, forming a wide elongated stream, hardly any with penumbra.
22. Spots quite as numerous but more scattered.
23. Greatly dimished, less than half the number.
24. Still more attenuated, spots very faint.

Feb. GROUP 56. *Long.* 188°. *Lat.* 32° S.
16. A spot near E. limb with large curved nucleus, and a singular loop in the penumbra on the n.f. side.
17. More nuclei, the loop remaining.
18. Large nucleus still curved and very jagged on the p. side, showing a difference in the depth of tint. Many smaller and very irregular nuclei, penumbra still opening on the f. side.
19. Nucleus bridged; penumbra encircling the whole.
20. Nucleus with a long narrow fissure streaming to the W. from the bridge. A black hole in the middle of the large chasm, the whole an enormous spot, in form quadrangular. Area 6,500 square seconds.
21. Nucleus more dense, fimbriated on both sides, the black hole very conspicuous with curved points of cyclonic shape to the W. of it. The whole very complicated, smaller nuclei more numerous, but decreasing in size.



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Feb. GROUP 56—*continued.*

22. On the central meridian, a striking difference in the tint of the p. portion of the nucleus, the darker evidently identical with the black hole (see "British Astronomical Association Journal," Vol. IV., No. 7, p. 300). The large nucleus diminishing since yesterday, but with a gigantic acanthus leaf of white photospheric matter, its stalk fixed in the middle of the spot and its blades turned towards the black nucleus; a cyclonic movement N.W.S.E. is conspicuous. Length 47,620 English miles.
23. Nucleus very jagged, in shape resembling a lobster, the s.f. part broken up, deeply fissured, and bent back as it were at right angles, the whole more perforated and containing an immense amount of detail.
24. A bridge across the densest part of the nucleus, the bent portion severed, smaller nuclei very variable in shape, some of the exterior ones dot-like.
26. Large nucleus broken up into several parts, the S. portion is now quite distinct and lengthened out.
27. Much fore-shortened and divided, the S. part a string of little nuclei with penumbra to the S.
28. Decreasing.

Feb. GROUP 57. *Long.* 153°. *Lat.* 26° S.

18. A penumbral spot, very near E. limb at 2 p.m.
19. Nucleus divided.
20. Nuclei more separated, small portions broken off.
21. A small spot on the f. side, apparently thrown out.
22. The uppermost of the two nuclei larger than the lower, which crescented. No outlying spot.
23. Major axis 50″. Lowermost nucleus linear.
24. Little change.
26. No details.
27. Nuclei in a quatrefoil.
28. Nucleus entire.

March.

2. Penumbra on the p. side.
3. Penumbra to the N.

Feb. GROUP 58. *Long.* 151°. *Lat.* 3° N.

19. A small penumbral spot near E. limb.
20. Penumbra on the f. side.
21. Normal.
22. Two small spots to the S.
23. No change. Major axis about 30″.
24. Decreasing.
26. No details.
27. Still decreasing, nucleus divided, one or two outliers.

Feb. GROUP 59. *Long.* 143°. *Lat.* 16° S.

19. A small spot near E. limb preceded by a few dots.
20. Normal, penumbra wider on the f. side, a small spot p.
21. Nucleus breaking up.
22. Nucleus more entire, a few small outliers, the p. spot gone.
23. Nucleus again dividing, a rent also in the penumbra, five dots f. close together.
24. Much elongated equatorially, many small nuclei, two dots f.
26. No details.
27. Both nucleus and penumbra severed, one spot and some tiny dots f.
28. The two portions smaller but more widely separated, the f. with two nuclei.

March.

2. One spot with penumbra s.p., the other almost gone.



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Feb. GROUP 60. *Long.* 261°. *Lat.* 4° to 5 S.
20. A number of very small spots in a quadrangular group.
21. Spots in three sets following each other.
22. One larger spot near W. limb.

Feb. GROUP 61. *Long.* 176° to 171°. *Lat.* 16° S.
21. A few very small spots.
22. A loose cluster, somewhat elliptical; spots all small interspersed with dots.
23. Two compound spots, 5° part, with major axis 30″ and 20″. Dots between them.
24. The leader more normal, the f. triangular, more outliers, f.
26. Decreasing.
27. Leader normal. A forward impulse has taken place between the 24th and 27th of 5°. The f. broken up. The whole group elongated.
28. Leader much diminished.

Feb. GROUP 62. *Long.* 128°. *Lat.* 25° S.
27. About three little spots near each other, three more f.
28. One spot larger.
Mar.
2. Leading spot, with penumbra on the p. side only, major axis 20″. Some dots f. more to the E.
3. Much diminished.
4. One very small spot.

Feb. GROUP 63. *Long.* 98°. *Lat.* 10° S.
27. A small black spot without penumbra, two still smaller f. at a distance.
28. Another round, black spot (like the shadow of one of Jupiter's satellites), 6° more to the S.
Mar.
2. No increase, the f. spots have disappeared.

Mar. GROUP 64. *Long.* 92°. *Lat.* 16° S.
2. A faint spot with slight penumbra, not far from the central meridian.
3. A pair of dots to the N. at some distance.
4. Not seen.
5. A miniature pair.
6. Near W. limb, very small.

Mar. GROUP 65. *Long.* 9°. *Lat.* 8° N.
4. Four little spots at some distance from E. limb.
5. A stream, components hardly larger than dots.
6. The p. dots, five of which were close to each other, have become an oval spot, in length 35″, with many small nuclei and penumbra s. f. The f. dots larger. Some hours later the nucleus had increased and become forked, the f. dots amalgamating and drawn out in a double row.
7. Nucleus elongated, a portion at the end as if torn off, the s. f. spots vanishing.
8. Leader more normal, the disjected portion with three nuclei and curved in an opposite direction. Area 720 square seconds.
10. Nucleus of leader broken up, a small irregular spot f., apparently the disjected portion.
11. Penumbra on the p. side, f. spot very small.
12. Smaller, nebulous, solitary.

Mar. GROUP 66. *Long.* 358°. *Lat.* 22° S.
4. A very small spot in the midst of faculæ.
5. A few more p.
6. Spots in an elliptical group. Very small.
7. Six dots in a stream.
8. Increased in area and more confluent.



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Mar. GROUP 67. *Long.* 331° to 325°. *Lat.* 3° to 4° S.

5. A small spot not far from E. limb.
6. Two little black spots.
7. The p. with nucleus out of proportion to the penumbra, three smaller f.
8. P. with double nucleus, still but little penumbra, one f.
10. Great increase, leader two-lobed with accompanying dots, more f. at a little distance mixed with penumbra.
11. Leader with penumbra only on the p. side, a wide stream of dots only f.
12. Leader with many small nuclei, the f. dots in curves.
13. Leader trifid, one penumbral spot f.
14. Spots small, including the leader, the most f. dots again forming an ellipse.
15. Spots increasing, but without penumbra.
16. In two sets, a great amount of faculæ.

Mar. GROUP 68. *Long.* 24°. *Lat.* 9° S.

7. Two little black spots and three dots.
8. Two dots.

Mar. GROUP 69. *Long.* 335°. *Lat.* 11° S.

7 Three dots, one very faint. (Between Group 67 and 70.)

Mar. GROUP 69A. *Long.* 337°. *Lat.* 18° S.

10. A few very small spots near the centre of disk.
11. Little change.
12. Three spots, another p.
13. One spot.

Mar. GROUP 69B. *Long.* 325°. *Lat.* 15° S.

10. A few dots.
11. One small nebulous spot.
12. Decreasing.
13. Little change.
14. Three sets of dots.
15. One small irregular spot.
16. Two dots, near W. limb.

Mar. GROUP 70. *Long.* 313° to 309°. *Lat.* 15° N.

7. A pair of small dark spots near E. limb.
8. Confluent, forming one spot, penumbra on the f. side.
10. Large, normal. To the S. a stream of little spots following the contour of the main one.
11. Small spots in front with penumbra at their head, comet-like, the f. swamped in the penumbra of the main one, but still visible as a narrow line.
12. Main spot very large, double, the two nuclei forming a perfect pair, but pointing in opposite directions, the comet-like spot separated, a few scattered outliers.
13. Main spot drawn out equatorially, the two large nuclei being now in a line. Penumbra beginning to divide between them, major axis 1′ 15″.
14. Two separate spots, each nearly normal. No outliers besides the p. spot, which has penumbra still only in front.
15. More widely separated. Nuclei splitting up. A few outliers.
16. No radical change.
17. Decreasing.
18. Near W. limb, diminished. Three spots, the two f. without penumbra.

Mar. GROUP 71. *Long.* 270°. *Lat.* 4° S.

10. A penumbral spot near E. limb.
11. Penumbra splitting on the f. side.
12. Nearly normal, a small fragment apparently thrown out.
13. Fragment more distant.



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Mar. GROUP 71—*continued.*

14. Nearly circular, solitary.
15. Major axis 35″. Nucleus bridged.
16. Elongating.
17. A small spot n. f.
18. Decreasing.
19. One dot f.
20. Penumbra slight.
21. Much reduced, a small spot n. f. at some distance.

Mar. GROUP 72. *Long.* 263°. *Lat.* 16° N.

10. A small penumbral spot near E. limb.
11. Little change.
12. Normal.
13. Penumbra splitting on the f. side.

Mar. GROUP 73. *Long.* 345°. *Lat.* 6° N.

13. A small nebulous spot more than half of sun's radius from centre.

Mar. GROUP 74. *Long.* 321° to 315°. *Lat.* 5° N.

13. A pair of little spots.
14. Larger, dark, three p. and one, in the form of a crescent, f.
15. Decreasing, again a pair, each double.
16. Dots only, in two sets widely separated.

Mar. GROUP 75. *Long.* 178°. *Lat.* 8° N.

17. A small spot not far from E. limb.
18. Penumbra very slight.
19. No penumbra.
20. Not seen.
21. One very small black spot.

Mar. GROUP 75A. *Long.* 144°. *Lat.* 26° S.

19. A very small normal spot.
20. A tiny semi-circular cluster.
21. One very small black spot.
22. Little change.
23. Three small spots in an isosceles triangle.
24. Two only.

Mar. GROUP 75B. *Long.* 171°. *Lat.* 32° S.

19. A very small spot at some distance from E. limb.

Mar. GROUP 76. *Long.* 133° to 126°. *Lat.* 7° N.

20. A compound spot, with a broken portion, only connected by a narrow isthmus, followed by two smaller ones.
21. A train, the leader more normal, but sphacelated on the f. side, the adjacent portion dissevered, one of the f. larger.
22. Two principal spots, the leader normal, the final one nearly double its area, with much penumbra, apparently from union with a p. spot.
23. Leader circular, but bridged and fimbriated, the final with large nucleus and penumbra in front still branching. Many sputterings and dots, three more distant.
24. Spots more connected and equalised, with a tendency to curves, the final one double.
25. Nearly central, spots separated, the leader and the final (now the largest) with dense nuclei, two smaller between. Outliers few.
26. Leader with divided nucleus, photospheric matter enveloping the p. part, the f. being veiled. Final spot much elongated.
27. Decreasing, leader broken in two, the final splitting centrally, a small black spot and a penumbral patch only remaining between. The dots to the N. have disappeared.
28. Fading away, the leading spots become two very small pairs. One of the f. still considerable, crescent shaped.



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Mar. GROUP 76—*continued.*

29. The f. spot alone remaining, except dots which precede, and also issue from it on one side, the penumbra encircling three.
30. Still diminishing by dissection and reduction of boundaries, the severed parts seem to sink and dissolve in the photospheric ocean, leaving very small black dots which last some time.
31. Near W. limb. Still decreasing.

Mar. GROUP 77. *Long.* 101°. *Lat.* 20° S.

23. A little crescent-shaped spot and a dot f.
24. A black dot only.

Mar. GROUP 78. *Long.* 129°. *Lat.* 25° N.

24. Two small spots lying N. and S. of each other, with smaller ones between.
25. No drawing.
26. The two spots very black, dots f. the most northerly.

Mar. GROUP 78A. *Long.* 70°. *Lat.* 14° N.

26. A small black spot at some distance from E. limb, in the midst of faculæ.

Mar. GROUP 79. *Long.* 57° to 46°. *Lat.* 9° N.

26. Two very small spots near E. limb.
27. A penumbral spot between four lesser ones.
28. A train, chiefly dots, one larger than the rest.
29. Spots drawn out in a line in single file, except the most p.
30. A leading spot of considerable size with one large nucleus and tiny ones to the N., the rest no longer continuous; at the rear a little star-shaped cluster.
31. Leader enlarged, with two nuclei and a wide bridge, a trail of small nuclei issuing from the n. f. side with branching penumbræ, irregular sputterings follow in a zigzag.

April.

1. Leader nearly vertical, one nucleus much larger than the other, and close to it; sputterings amalgamating, two of them distinct spots, the larger nearly 30″ in length.
2. Leader 1′ of arc in diameter, nuclei more equal, but narrowed and angular, penumbra extending on the n. f. side containing miniature nuclei, which suggest the absorption of neighbouring spots. More small outliers f.
3. Leader a huge normal spot, nucleus entire, the f. much dwindled, one only of any importance.
4. Nucleus tapering, the f. still on the wane.
5. Leader little changed, a small pair only f.
6. Signs of a division; penumbra nearly equal on the p. and f. side.
7. Close to W. limb at 10.45 a.m. A slight depression or flatness of the curvature of the limb was observed, possibly arising only from the difference in shade between the penumbra and the limbs.

Mar. GROUP 80. *Long.* 86° to 81°. *Lat.* 16° S.

27. A pair of small spots, three more f.
28. Two pairs, more widely separated.
29. One small spot.
30. A pair, dots between, and s. f.

Mar. GROUP 80A. *Long.* 38°. *Lat.* 22° S.

27. A small spot followed by a tiny group of three.
28. More widely separated.
29. One very small spot.
30. A pair, little sputterings between and s. f.



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Mar. GROUP 81. *Long.* 39° to 27°. *Lat.* 17° to 22° N.

27. A small spot close to E. limb.
28. A cluster, very little penumbra.
29. Four principal agglomerations of nuclei and penumbra, besides dots and sputterings.
30. An enormous increase, two large compound spots, the p. (A.) with beautiful ramifications in the nucleus, the f. (B.) with penumbra chiefly confined to the E., and several nuclei, probably a combination of three spots seen yesterday; sputterings between the two.
31. Further increase. A. oval, nucleus almost entire, a stream of distinct spots, apparently offshoots from the pointed extremities, with linear nuclei stretching out, connecting it with the large f. spot B. which is also more consolidated, the nucleus with a black hole in it, and a bridge, while fissures, four in a row, stream from it on the n. p. side, penumbra curling round and encircling the whole. Area of both spots 4,000 square seconds.

April.

1. A. double, with two elongated nuclei lying N. and S. of each other. B. roughly triangular, composed of one large spot, nearly normal, with wedge-shaped nucleus and two portions just detached, the connecting stream dissolved, outliers few.
2. Crossing the central meridian. A. a wonderful mass of nuclei surrounded with penumbra, in form oblong. B. with the nucleus bridged in several places. One of the detached portions enlarged, a string of small nuclei curving round in front. Area of A. 2,800 square seconds. B. 3,000.
3. A. again consolidated with two large nuclei, one crescented the other somewhat pear-shaped. It appears to be turning round the nucleus to the N. as on a pivot, the one to the S. advancing to the W., thus causing the space between A. and B. to become wider; an irregular stream of sputterings almost connect it with B., which has undergone considerable change, the wedge-shaped nucleus being forked at one end and barred at the other, the severed portions decreasing.
4. A. almost split in two; the two nuclei quadrangular. B. still of great size, nearly equalling A., but more broken up on the p. side; the nuclei much altered in form.
5. A. breaking asunder towards the equator, the nucleus to the S. much narrowed. B. is in two sections almost at right angles to each other, with curved and divided nuclei. Few sputterings between. (N.B.—A. has shown a retrogadation of 4° Long.)
6. A. a double spot only united on the f. side, "having turned completely round," the two nuclei still conspicuous, forming a semi-ellipse with the opening towards the limb. B. still more broken up. The f. nuclei deeply fissured; a wide vacant space in the centre.
7. A. near W. limb, the truncated half somewhat diminished. B. gradually dissolving and more separated.
8. A. invisible. B. fainter than yesterday.

April. GROUP 81. *Long.* 16° to 12°. *Lat.* 7° N.

5. Two little irregular spots some distance apart, f. Group 82.
6. Smaller.
7. Hardly more than dots.

Mar. GROUP 82. *Long.* 23°. *Lat.* 14° N.

28. A penumbral spot with two nuclei.
29. Penumbra gaping to the S.
30. The nucleus to the S. with a hook.
31. Normal, circular, two tiny spots f. at some distance.

April.

1. Little change, a few dots p. Distant spots not seen.
2. Area 450 square seconds. This spot seems beyond the region of activity occupied by Group 81.
3. A small spot f.
4. Another more distant.



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Mar. GROUP 82—*continued.*

5. The more distant not seen.
6. Nucleus forked at the end, possibly from absorption of the adjacent spot.
7. Normal.
8. Penumbra nearly equal on both sides.

Mar. GROUP 82A. *Long.* 99°. *Lat.* 25° N.

28. Two tiny but very conspicuous pairs.
29. Dots only.
30. A very small spot and a tiny cluster of dots f.

Mar. GROUP 83. *Long.* 336°. *Lat.* 15° S.

31. A very small spot close to E. limb.

April.

1. Some outliers.
2. An irregular group, some spots with slight penumbra, a short trail f.
3. A little stream somewhat zigzag, one spot only penumbral.
4. Stream lengthened and expanded; the leader larger than the rest.
5. Two leading spots, stream more in a straight line.
6. Much increased, a mass of small spots, with penumbra and dots.
7. Spots larger, in two principal sections, no longer in a line, the most f. double.
8. Leading spots much smaller, the f. single but broken up with a few attendants.
9. The f. spot normal, solitary, penumbra confined almost entirely to the W. side; major axis 40′.
10. The p. spots gone, the f. bridged, two new ones at a little distance.
11. The f. normal, new ones very small.
12. Near W. limb, little change.

April. GROUP 84. *Long.* 69°. *Lat.* 12° N.

2. A pair of small spots p. Group 79, only observed on this date.

April. GROUP 85. *Long.* 0°. *Lat.* 28° S.

3. A little pair.
4. A wide pair.
5. One spot.
6. A pair with a tiny one f.
7. Two irregular penumbral spots.
8. Still larger, the f. double, nearly 45″ major axis, both with several nuclei.
9. More normal, the f. broken asunder, forming two spots.
10. Near W. limb, the two f. more equal.

April. GROUP 86. *Long.* 294° to 282°. *Lat.* 15° to 18° N.

4. A small normal spot.
5. Penumbra equal on both sides.
6. Little change.
7. A smaller penumbral spot f. with a few outliers.
8. Little change in the leader, but a complete train of small spots f., for the most part with penumbra.
9. Enormous increase in the f. Two principal spots, each more than 1′ in length, the first very complicated, with nuclei much divided, streaming out at the extremity, the last with three nuclei, and vertical.
10. Much disintegrated, a wonderful train of fragmentary spots, two still predominating although much altered. Area 2,700 square seconds.
11. More compact.
12. General surface augmented, spots still much divided but in two sections. The vertical spot split up and turned to the equator.



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April. GROUP 86—*continued.*

13. First section more concentrated, with six nuclei circling round each other, the last very fragmentary, penumbral streamers between the two.
14. Slowly diminishing, the first section less concentrated.
15. Near W. limb.

April. GROUP 87. *Long.* 339° to 329°. *Lat.* 11° to 13° N.

6. Two very small spots, three dots f.
7. Great increase, an irregular stream of about 10, parallel to the equator, one or two with penumbra.
8. Leading spot nearly normal.
9. Leader with a trail of dots f., two small spots further off.
10. Decreasing, the f. dots in a line, one distant spot.
11. One spot.

April. GROUP 88. *Long.* 232°. *Lat.* 25° S.

8. A dot near E. limb.
9. Increasing.
10. Decreasing.

April. GROUP 89. *Long.* 190° to 176°. *Lat.* 15° S.

12. A few small spots near E. limb.
13. Nearly normal, three dots s. f.
14. Nucleus triangular, five outliers.
15. Outliers larger.
16. Leading spot with two nuclei, the rest following in a double line, the last increased.
18. Leader broken up, the last with irregular nuclei, a few dots and penumbral patches between. Area 370 square seconds.
19. Leader more normal, the last spot dispersed and become a fragmentary cluster.
20. Leader splitting into three; the cluster condensed, with more penumbra.
21. Leader decreasing, the cluster is now a stream.
22. Leader vanishing, and instead of the stream a large spot with divided nucleus and penumbra only on the p. side. Area 600 square seconds.
23. Leader a tiny pair; f. spot in two sections, much disintegrated penumbra on the f. side.
24. The f. only visible.
25. One small spot close to W. limb at 9.54 a.m.

April. GROUP 90. *Long.* 153°. *Lat.* 13° S.

14. A normal spot near E. limb, penumbra wider on the f. side.
15. Nucleus divided.
17. More normal.
18. Nucleus large, fimbriated, with a small one on the s. f. side, diameter 42″.
19. Little change.
20. Outline irregular; two outlying dots.
21. Nearly circular.
22. Small nucleus now close to the large one.
23. Little change.
24. Small nucleus united to the large.
25. Small nucleus again disunited.
26. Near W. limb.
27. Close to limb, like a line.

April. GROUP 91. *Long.* 152°. *Lat.* 6° S.

14. A very small spot N. of 90.
15. Little change.
17. Ditto.
18. Decreasing.
19. A dot s. f.
20. Very small.



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April. GROUP 92. *Long.* 90° to 78°. *Lat.* 15° to 21° S.

19. A small normal spot near E. limb.
20. Penumbra wider on the f. side; a little nucleus on the edge. A few outlying dots.
21. A small spot f.
22. Fragmentary spots f. in a broad stream.
23. Vastly increased. Two large spots, the f. formed from one of the fragmentary ones of yesterday, exceeding the p. in area, with a curved nucleus.
24. Spots in a train, more confluent, the p. normal, the f. with two nuclei, one of them large and quadrangular, penumbra stretching out and enveloping the smaller followers now much enlarged. Area 2,400 square seconds.
25. Train less sinuous and more inclined to the equator; four principal spots, the p. with a tiny stream f., the others tapering, with wispy penumbra; very complicated.
26. Three principal spots, disconnected but more regular.
27. Again more dissected and intricate, the largest forked with a black hole in the nucleus. Many dots and outliers.
28. Greatly diminished; three spots still prominent.
29. Two prominent spots.
30. One larger than the rest.

May.

1. Near W. limb.

April. GROUP 93. *Long.* 90° to 80°. *Lat.* 29° S.

22. Two very small spots S. of Group 92.
23. A large cluster, forming a sort of double ellipse, the first and last spots larger than the rest which are sharp and unclear, in all about 24. Length 1′ 30″.
24. Spots more in a line and fewer, the first and last more normal.
25. Spots between the first and last decreasing.
26. The first and last only left, each with double nucleus.
27. Nuclei more irregular.
28. The first spot decreasing, the last reduced to a small pair.
29. Little change.
30. One small spot.

May.

1. Near W. limb two dots and a tiny pair f.

April. GROUP 94. *Long.* 61°. *Lat.* 18° S.

22. A small irregular spot following Group 92.
23. A little pair.
24. No change.
25. Not increased.
26. One very small spot.
27. A dot.

April. GROUP 95. *Long.* 55°. *Lat.* 12° N.

22. A normal spot near E. limb. (Return of Group 79.)
23. Nucleus bridged.
24. A small spot f.
25. Two nuclei, one large and pear-shaped.
26. Nucleus entire.
27. Nucleus jagged, with a black hole in it; more outliers s. f.
28. Nucleus bridged longitudinally.
29. Little change.
30. Normal.

May.

1. Nucleus indented on three sides.
2. More regular.
3. Little change.
4. Very near W. limb at 8.50 a.m.



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April. GROUP 96. *Long.* 48°. *Lat.* 22° N.
22. A small spot n. of. 95.
23. Nucleus curved.
24. In the form of a C. Area 200 square seconds.
25. Much divided.
26. Double.
27. A few outliers.
28. Decreasing.
29. A little pair.
30. Very small.
May.
1. Nucleus double, but no increase.

April. GROUP 97. *Long.* 21°. *Lat.* 15° N.
25. A penumbral spot near E. limb. Nearly the position of 82.
26. Little change.
27. Nucleus rather angular, a tiny dot n.p.
28. Nucleus quadrangular. The dot is now a small but conspicuous pair.
29. Little change.
30. No outliers seen.
May.
1. Penumbra on the f. side.
2. Decreasing.
3. Still smaller.
4. A mere dot.

April. GROUP 98. *Long.* 357° to 344°. *Lat.* 26° to 30° S.
26. A large spot very near E. limb at 1.24 p.m. A small one to the S.
27. Two compound spots following each other with a few outliers.
28. The p. more normal with two large nuclei, the f. with three and an opening to the N.
29. More widely separated.
30. The p. increasing, the f. decreasing.
May.
1. Nuclei of p. in curves and points, the spot to the S. with three nuclei in a row. The f. with several openings in front and a mass of faculous light in the centre.
2. The p. with two principal nuclei, the f. opening in the opposite direction to yesterday.
3. More normal. Area 2,800 square seconds.
4. The p. much the larger, in shape triangular, one nucleus round and very black, the other branching; a penumbral trail to the S. The f. with two nuclei. Area of both, 2,700 square seconds.
5. Surface decreasing, nuclei of large spot in bars; outliers in little streams. The f. spot with a nucleus detached.
6. Breaking up, penumbra spreading to the N. Outliers circling round in front.
7. Much divided, two principal nuclei, f. spot much smaller.
8. Diminished as well as foreshortened; inclined to form one more regular spot.

April. GROUP 99. *Long.* 324° to 318°. *Lat.* 4° S.
30. A small spot; one f.
May.
1. Surrounded by small spots and dots; a little spot s. f.
2. Nucleus double, two outliers and one dot.
3. Three spots.
4. Diminishing, more outliers.
5. Two spots furthest apart, the p. a little pair.
6. Very small.
7. Still decreasing.

May. GROUP 100. *Long.* 312° to 305°. *Lat.* 10° N.
1. Two tiny groups s. p. 101.
2. A stream of very small spots.



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May. GROUP 101. *Long.* 296° to 283°. *Lat.* 17° N.
1. A spot near E. limb with penumbra on the f. side, smaller ones to the N.
2. Two principal spots, the larger with several nuclei.
3. The larger lengthening out.
4. No radical change, stragglers in two sets. The p. with as many as seven nuclei and but little penumbra, the f. normal, stragglers in a vertical line to the E. A small spot at some distance s. p.
5. The p. a stream of distinct spots, the f. with penumbra to the W. Two new spots in a line, 8° to 10° p.
6. Stream dwindling.
7. The p. more clustered, the f. one double; a striking number of pairs, including spots in Group 104.
8. More scattered, all slightly decreasing.
10. Many small spots.
12. Near W. limb

May. GROUP 102. *Long.* 19° to 17°. *Lat.* 17° S.
2. A pair of small spots past the centre of disk.

May. GROUP 103. *Long.* 291°. *Lat.* 27° N.
4. A wide pair of small spots.
5. Little change.
6. No increase.
7. Decreasing.

May. GROUP 104. *Long.* 266°. *Lat.* 20° N.
3. A penumbral spot near E. limb.
4. Penumbra on the f. side.
5. Decreasing, a tiny pair n. f.
6. Little change.
7. Two nuclei, penumbra wanting.
8. A small semi-circle of nuclei.

May. GROUP 105. *Long.* 279°. *Lat.* 6° S.
7. An elliptical group of small spots, about 13° E. of central meridian.
8. About 11 in number—a stream.
10. Little change.

May. GROUP 106. *Long.* 316°. *Lat.* 24° N.
10. A small spot preceding Group 101. (Only observed on this date.)

May. GROUP 107. *Long.* 314°. *Lat.* 1° S.
11. A little spot 4° N. of Group 99.

May. GROUP 108. *Long.* 284°. *Lat.* 4° S.
10. A small spot in the Western hemisphere.

May. GROUP 109. *Long.* 197°. *Lat.* 6° N.
10. A spot at some distance from E. limb.
12. No details.
13. Area, 50 square seconds. A small companion to the N.
14. Solitary.
15. Two dots to the N.
16. Very small.

May. GROUP 110. *Long.* 185° to 175°. *Lat.* 11° to 17° S.
10. One or two little spots not far from E. limb.
12. A normal spot; a few smaller f.
13. Great increase. Area 1,040 square seconds.
14. A splendid group; four principal centres of activity; nuclei very irregular, full of bridges and points; abundance of dots and sputterings.



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May. GROUP 110—*continued.*

15. The leading spots enlarged, forming a wonderfully complicated mass, with sharp nuclei surrounding an almost central space filled with faculous matter. The f. altered in position, those to the S. more in a line, those to the N. divergent and more numerous. Length of group 175″.
16. Leading spots all much altered in shape and position, central space almost filled up, several conspicuous bridges, the f. more condensed, leaving only dots and penumbral patches between the two principal centres of activity.
18. Nuclei fewer but larger. One of the f. exceeding any of the others, with fissures towards the W. and a small black hole in the f. edge, great masses of penumbra streaming from it.
19. Again more intricate, with dissevered and barred nuclei, a magnificent chaos.
20. Nuclei decreasing, but an immense amount of penumbra encroaching upon the intervening space, almost merging the two centres into one mass.
21. Near W. limb, one of the f. nuclei much elongated.
22. Three of the principal spots almost close to the limb lying N. and S. of each other.

May. GROUP 111. *Long.* 183°. *Lat.* 19° N.

12. Two small spots at some little distance from E. limb.
13. One very small spot.
14. Several.
15. A leading spot with penumbra towards the W., three nuclear ones f.
16. Leader normal, the f. decreasing.
18. The leader only seen.
19. Decreasing.

May. GROUP 112. *Long.* 263°. *Lat.* 11° N.

14. A tiny pair very near W. limb, among faculæ.

May. GROUP 113. *Long.* 154° to 138°. *Lat.* 10° to 15° S.

12. Several spots near E. limb.
13. A train of irregular but distinct spots.
14. Nearly as complicated as Group 110, five centres of activity, the most p. spot in a roughly quadrangular form, one of the nuclei very large, the penumbra on the p. side. Many dots and outliers; a tiny pair p. and another f.
15. Enlarged, the p. altered in position and became still more quadrangular, the large nucleus turning to the S. The f. also increased and having two prominent spots.
16. The p. spots more compact, five large nuclei, two to the S. connected, the f., disposed in curves. Area, 3,700 square seconds.
18. Breaking up. The p. more in the form of a triangle, a great number of dots and sputterings f. Whole group curved; changes constantly taking place.
19. Two nuclei larger than the rest; identification difficult, several spots appear to have split asunder.
20. On the wane, more subdivided.
21. Again more condensed, one separate spot in advance of the rest.
22. No decided change.
24. At 9.15 three spots near W. limb, the foremost having vanished.

May. GROUP 114. *Long.* 205° to 203°. *Lat.* 14° to 18° S.

14. A nebulous spot not far from the centre of disk.
15. A few very small outliers.
16. Only two; decreasing.
18. Much increased, two penumbral spots, the p. changing rapidly, the f. nearly normal with two nuclei, dots between.
19. Nearly equal. Area, 250 square seconds.

May. GROUP 115. *Long.* 126°. *Lat.* 15° S.

16. A little cluster, hardly more than dots.
18. Two spots following each other with slight penumbra, a few dots enlarging.



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May. GROUP 115—*continued.*

19. Increased, especially the p. which has several nuclei, some scattered outliers.
20. The p. normal, the f. dispersing.
21. The p. half-moon shaped; three widely separated spots f.
22. At 9 a.m. the p. nearly circular, a curved stream of small spots f. Much increased at 6 p.m.
24. P. with two nuclei, the f. spots larger but fewer.
25. Three very small black spots and about six dots among faculæ.
26. One spot.

May. GROUP 116. *Long.* 120°. *Lat.* 11° N.

18. A few very small spots in two sets.
19. More scattered.

May. GROUP 117. *Long.* 106°. *Lat.* 25° N.

18. Two or three little spots (only observed by the Rev. F. J. Eld).

May. GROUP 118. *Long.* 87°. *Lat.* 17° S.

18. A small penumbral spot.
19. Normal.
20. Irregular, small.
21. Three little spots, close together, parallel to the equator.
22. Three spots in a vertical line, widely separated.
24. Two, near each other.
25. One.

May. GROUP 119. *Long.* 67°. *Lat.* 4° S.

18. A large spot and two smaller f. near E. limb.
19. Largest with three nuclei, penumbra on the p. side.
20. Small followers dispersing.
21. Two nuclei; the f. a mass of penumbra joined to the p. by a narrow isthmus.
22. At 9.15 part of the p. dissevered, the f. inclined to the S. At 4.18 the largest nucleus dividing, the penumbra of the f. very transparent.
24. In the form of a horseshoe, the f. fragmentary.
25. In two halves, nuclei tapering; dots in tiny streams f.
26. More in contact.
27. A pair—very little penumbra.
28. Re-united; more penumbra.
29. Very small.

May. GROUP 120. *Long.* 54°. *Lat.* 20° S.

18. A normal spot, near E. limb.
19. A larger one f.
20. Each with two nuclei; two little spots f.
21. The p. split in twain, decreasing, the large spot with more nuclei and showing signs of division; many scattered outliers.
22. Three little spots p., the larger one became a pair; outliers fewer.
24. The pair wider apart with penumbra on one side only. Outliers more numerous but widely dispersed.
25. A perfect pair, nearly circular; outliers altered in position.
26. Further apart; outliers fast vanishing.
27. Still more separated, one with two nuclei.
28. Little change.
29. Decreasing.
30. Very small, no outliers.
31. Faint.

May. GROUP 121. *Long.* 16°. *Lat.* 3° S.

22. A small spot near E. limb.
24. Nearly normal.
25. Penumbra only to the S.
26. Normal, circular.
27. Little change.
28. Little change.
29. Decreasing.



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May. GROUP 121—*continued.*
30. Decreasing.
31. Little change.
June.
1. Little change.

May. GROUP 122. *Long.* 355°. *Lat.* 12° N.
24. A large normal spot about one degree from E. limb.
25. Nucleus large and dense. Two small followers.
26. Less regular; more outliers, one only with penumbra.
27. Nucleus with a large protuberance to the W.
28. Signs of division. Major axis more than 1′.
29. Nucleus bridged.
30. Little change.
31. Little change.
June.
1. Nucleus nearly entire.
2. Nucleus with a black hole in it, and a dazzlingly white bridge N. and S.
3. Breaking asunder.
4. Detached portion almost gone.

May. GROUP 123. *Long.* 315°. *Lat.* 15° N.
26. A large spot near E. limb at 3 p.m.
27. Normal.
28. Little change.
29. Two-lobed, a tiny trail of dots f.
30. Little change; diameter 1′ of arc.
31. Signs of a bridge.
June.
1. Nucleus entire but more angular.
2. Black hole in nucleus, f. part bridged vertically, f. trail more pronounced.
3. Nucleus jagged.
4. Turning a little; black hole still visible.
5. A small part of the nucleus detached.
6. Very pointed—trail still f.
7. At 9.12. The impression of its being a depression irresistible (Pereira); a curved bridge across the nucleus. Trail extending along the f. side.
8. Observed by Mr. Wykes as a notch in the limb at 10$^h$.

May. GROUP 124. *Long.* 32°. *Lat.* 23° S.
27. About four little spots, n. f. 120.
28. Two pairs.
29. No details.

May. GROUP 125. *Long.* 320°. *Lat.* 6° S.
28. Three little spots in a triangle.
29. A little larger.
30. In a stream.
31. One spot only seen.
June.
1. One spot only seen.

May. GROUP 126. *Long.* 299°. *Lat.* 3° S.
29. A very small spot at some distance from E. limb.
30. Two, almost circular, with a little penumbra f. each other.
31. Little change.
June.
1. Little change.
2. Irregular, a small pair further N.
3. Two spots.
4. One, very small, and three faint dots.
5. One only.



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May. GROUP 127. *Long.* 343°. *Lat.* 0°.
31. Two little spots widely separated, near centre (resembling 126).
June.
1. A stream of dots f.
2. A nearly normal spot—penumbra faint, seven dots f.
3. One spot f.
4. A tiny cluster of dots f.
5. Near W. limb.

May. GROUP 128. *Long.* 271°. *Lat.* 16° N.
30. A very small spot not far from E. limb.
31. Little increase.
June.
1. Three spots.
2. A penumbral spot tapering at the end, a pair p. and a few f.
3. No details.
4. Oblong, nucleus indented, outliers in four sets in a line, far apart.
5. Bridged; nuclei pointed; only three sets.
6. Bridge wider, a little cluster to the N.; one spot and dots f.
7. Three-lobed, cluster increased. None f.
8. Normal, one spot only seen to the N.
9. Irregular.
10. Much reduced, solitary.

June. GROUP 129. *Long.* 299°. *Lat.* 27° S.
2. A very small spot, three dots f.
3. Not seen.
4. Two spots.
5. A little pair.

June. GROUP 130. *Long.* 275° to 267°. *Lat.* 5° S.
2. A very small spot.
3. Rapid increase, two irregular spots.
4. The p. more normal, with curved bridge, dots and sputterings between the two. Area, 650 square seconds.
5. P. with two nuclei, the f. decreasing.
6. P. with a curious rectilinear bridge; a tiny stream f.
7. Normal, penumbra with a point to the N. A cluster of five dots f. and two to the S.

June. GROUP 131. *Long.* 218°. *Lat.* 12° S.
3. A small spot near E. limb.
4. Several.
5. No details.
6. An irregular stream of very small spots and dots.
7. The most f. larger, with penumbra to the E.
8. The f. very compound.
9. Some of the p. increased.
10. P. little altered, the f. more compact.
11. The p. few and small, the f. triple.
12. One spot only p. The f. single, with several nuclei, penumbra on the f. side.
13. Dots only p., the f. still one-sided.
14. Penumbra on both sides.
15. Close to limb at 9.35.

June. GROUP 132. *Long.* 212°. *Lat.* 20° S.
4. A small spot with slight penumbra.
5. Little change.
6. A trifle larger.
7. Nebulous.
8. Little change.
9. A pair.
10. Much the same.
11. Single.



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June. GROUP 133. *Long.* 202°. *Lat.* 6° N.? (J.S.T. 3° N.)

4. A small spot and dot near E. limb.
5. A few more.
6. About 12 spots.
7. One dark spot, dots surrounding and f.
8. Much the same.
9. Two pairs, the p. very small.
10. No details.
11. One spot, a very faint stream f.
12. Increased; two penumbral spots.
13. One spot, very compound, with sharp nuclei, and diaphanous penumbra.
14. More normal, major axis 35″. Penumbra to the S., with tiny nuclei.
15. Smaller.

June. GROUP 134. *Long.* 190° to 179°. *Lat.* 16° to 20° S.

6. A loose cluster near E. limb. Several medium-sized spots with dots and outliers. (A return of Group 110.)
7. A great amount of faculæ, spots very irregular.
8. One larger than the rest.
9. A train, narrowing at the end, one p. spot normal, the f. interspersed with penumbral patches. A small spot to the N.
10. The f. part, consisting of a large penumbral patch, containing only a few very small nuclei.
11. Train in three sections; two spots leading, the penumbral patch dispersing.
12. Much lengthened out, one leading spot 45″ in length, the rest all diminished.
13. Leader normal, the f. in a stream expanding at the end, very misty.
14. The f. fewer. At 4.35 p.m. condensed at the extremity, and forming a bubble-shaped spot.
15. Two spots only conspicuous, the final one-sided, fan-shaped, and vapourous, a few outliers.
16. More scattered spots. N.B.—This group began and ended as a loose cluster, becoming on intermediate days first a train and then a stream.

June. GROUP 135. *Long.* 161° to 156°. *Lat.* 14° to 17° S.

8. A few little spots f., Group 134.
9. About 10, chiefly nuclear.
10. Leading spot much increased, a miniature cluster f.
11. Leader compound, cluster more compact.
12. Leader with two narrow nuclei, penumbra to the S., cluster not seen, a tiny stream of dots f.
13. Leader more normal, circular, the cluster re-appearing in the shape of a spot nearly equal to the leader, a few dots near each. Area, 200 square seconds.
14. Both on the wane.
15. Three small spots.

June. GROUP 136. *Long.* 158° to 153°. *Lat.* 4° to 6° S.

9. Two very small spots near E. limb.
10. The p. gone, the f. larger.
11. A little stream, spots in pairs.
12. In two sections, penumbra slight.
13. More continuous.
14. Leading spot increasing.
15. A great increase, two spots, the p. 45″ major axis, more vertical, with several nuclei; the f. about 30″, two-lobed, penumbra dark, a few stragglers between.
16. The p. with nuclei sharply divided, one a mere line, the f. diminished.
17. P. normal, nucleus double, f. very small.
18. P. with penumbra wider on the p. side, f. much reduced.
19. Near limb, f. very small.



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June. GROUP 137. *Long.* 130° to 118°. *Lat.* 7° to 12° N.

10. A normal spot.
11. Breaking up on the f. side, a small spot to the E.
12. Nucleus triple, dots f.
13. More normal, nucleus pear-shaped, small spots dispersed, dots larger.
14. At 8 a.m. nucleus oval, drawn out and hooked at the end; at 5.45 curved, with a bob at the end.
15. Two spots, nearly circular; in place of the dots a small penumbral spot.
16. The most p. pear-shaped, at 6 p.m. singular narrow fissures at the extremity, the f. on the wane, some small outliers, the penumbral spot became a tiny stream.
17. Both spots increased and almost in contact, with nuclei pointing in opposite directions, more spots f. in a zigzag.
18. Spots all more connected, the final one large, with wedge-shaped nucleus curving slightly upwards.
19. Very complicated, spots looped together with penumbra and many nuclei, forming a massive train, the p. elongated, the final with several nuclei curving downwards, and exhibiting rapid changes.
20. Much foreshortened, spots more separate, nuclei smaller, the p. cup-shaped, showing a red tint at 5.45 p.m. *See* "Journal," No. 9, p. 387, Vol. IV.
22. Near limb, one large spot at 10.30, a smaller one in advance.

June. GROUP 138. *Long.* 102°. *Lat.* 9° N.

12. A normal spot, with double nucleus near E. limb.
13. Nucleus more divided.
14. Splitting in two.
15. Connected only by a very narrow isthmus.
16. Nuclei more consolidated.
17. A pair, nearly circular. Area 900 square seconds.
18. More widely separated, the f. smaller.
19. The p. normal.
20. P. with two nuclei, the f. almost gone.
21. One spot, nucleus entire.
22. A small outlier.
23. Near limb, solitary.

June. GROUP 139. *Long.* 174°. *Lat.* 19° S.

13. A tiny stream of dots only just visible f., Group 134.
14. Two or three faint spots.
15. In two sets.
16. Mere dots and one small penumbral spot.
17. Great increase, one large spot with smaller ones to the N. of it.
18. Near W. limb, a large spot with two nuclei.

June. GROUP 140. *Long.* 148°. *Lat.* 5° N

13. Three little spots in a line.
14. A few more, in two sets, on the central meridian.
15. A stream.
16. Three, in a line.

June. GROUP 141. *Long.* 81° to 67°. *Lat.* 13° to 16° S.

13. A large spot very near E. limb at 10 a.m.
14. Nucleus divided, outliers to the N. and f.
15. Nucleus with a narrow bridge, f. spots larger.
16. Nucleus two-lobed, f. spots chiefly consisting of penumbra.
17. Elongated equatorially with penumbral appendages, the f. in a zigzag.
18. A magnificent spot, nucleus with two black holes, fimbriated, the f. becoming fragmentary.
19. Nucleus more curved, a bridge observed at 10, black holes still visible, penumbral appendage much drawn out, and uniting with some of the f. spots; area 4,600 souare seconds.



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June. GROUP 141—*continued.*

20. Nucleus in three divisions, showing a lighter tint to the N.; penumbra still branching at the rear; major axis 1′ 15″.
21. Nucleus in two divisions, difference in tint very slight, penumbra and f. spots somewhat decreasing.
22. Nuclei very large, the p. curved, the f. more quadrangular, a narrow isthmus between penumbra and f. spots also curving.
23. Nuclei more regular.
24. Much foreshortened, a very narrow isthmus between the nuclei on the f. side at 6 p.m.
25. Very bright between the nuclei, no isthmus.
26. Close to W. limb at 10.30 a.m.

June. GROUP 142. *Long.* 174°. *Lat.* 11° N.

16. Two little spots not far from W. limb.
17. One spot in the midst of faculæ.

June. GROUP 143. *Long.* 117° to 113°. *Lat.* 10° to 12° S.

17. A pair of very small spots some distance apart.
18. Much increased.
19. Nearly equal and normal, major axes about 40″, the f. with two nuclei.
20. Decreasing.
21. The p. much smaller.
22. One spot, nearing W. limb.

June. GROUP 144. *Long.* 110° to 103°. *Lat.* 19° to 22° S.

18. A few small spots in two sets following Group 143, and in many points resembling it.
19. Changing and increasing rapidly, the f. and largest with sharp nuclei curving eastward.
20. Two elongated pretty regular spots, inclining at an angle to each other, with beaded nuclei, length about 40″.
21. Altered in form and more widely separated.
22. Both double, one of each pair having two nuclei.
23. The p. very near W. limb at 9 a.m.

June. GROUP 145. *Long.* 360°. *Lat.* 12° N.

19. A large spot very near E. limb at 9 a.m., penumbra on the f. side.
20. Normal.
21. A small outlier to the N.
22. Nucleus large.
23. Circular.
24. Nucleus more fimbriated, six outlying dots.
25. A narrow elbow-shaped black hole in nucleus, and a rent in penumbra to the S.
26. Nucleus more oblong, outliers increasing in number.
27. Two more distant outliers.
28. Little change, no outliers seen.
29. One outlier.
30. Nucleus tapering, penumbra nearly equal on both sides.

July.

1. Near W. limb at 5.45 p.m.

June. GROUP 146. *Long.* 349°. *Lat.* 2° S.

20. A small spot near E. limb.
21. Very little penumbra.
22. Increasing.
23. Signs of disruption.
24. Normal, nucleus lighter centrally, as many as 10 outlying minute dots, at 6 p.m. one of them larger.
25. At 8.42 nucleus curled, two hours later divided; no outliers.



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June. GROUP 146—*continued.*

26. At 7.40 a.m. nucleus curving eastward, at 10.30 in the form of an anchor.
27. Normal, nucleus undivided.
28. Very little change.
29. Much smaller.
30. Very small.

July.

1. Two very faint spots.

June. GROUP 147. *Long.* 317°. *Lat.* 13° to 16° N.

23. A spot near E. limb at 5.12 p.m.
24. Penumbra on the p. side.
25. Nucleus dividing, some fragmentary spots adjacent to the S.
26. Main spot more normal.
27. Nucleus angular.
28. Fragmentary spots s. p.
29. Broken up.
30. Two small spots widely separated.

July.

1. One spot.
2. A tiny black spot; dots in the neighbourhood.
3. Not seen.
4. Near limb, one spot and a great amount of faculæ.

June. GROUP 148. *Long.* 307°. *Lat.* 9° N.

23. A small spot near E. limb.
24. One outlier.
25. Nearly normal; area 200 square seconds.
26. Two outliers.
27. Nucleus dividing.
28. A double spot.
29. Two small spots, quite distinct, a few dots f.
30. A pair, very small.

June. GROUP 149. *Long.* 31°. *Lat.* 9° S.

25. A few very small spots about half of sun's radius from the centre.
26. Rather more, in the form of a trapezium.
27. In the midst of faculæ, hardly visible.

June. GROUP 150. *Long.* 324°. *Lat.* 12° S.

27. Two very small spots, nearly one day E. of centre.
28. At 9 a.m. immense increase, an elliptical cluster of about a dozen spots, the most p. normal, the rest dark with but little penumbra, at 6.25 p.m. more in number.
29. At 8 a.m. in a stream with more penumbra, five of the p. almost in contact, at 6.15 p.m. separating.
30. Three distinct spots, the last double.

July.

1. Again split up into small spots.
2. About six, in a curved stream, many faculæ.

June. GROUP 151. *Long.* 276°. *Lat.* 13° S.

28. A few very small spots at some distance from E. limb.
29. More, in two sets.
30. Two, further apart.

July.

1. Hardly visible.
2. Another pair to the N., inclined in a different direction.



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June. GROUP 152. *Long.* 248°. *Lat.* 2° N.

29. A few little spots some distance from E. limb.
30. A wide pair.

July.

1. Rather more in number.
2. A scattered group of some 24 small spots and dots.
3. A wide pair in advance.
4. The most f. larger, those in advance not seen.
5. Again a wide pair; the f. spot decreased.
6. Dwindling.

July. GROUP 153. *Long.* 217°. *Lat.* 7° N.

1. An insignificant spot near E. limb.
2. Irregular, penumbra to the S., one or two smaller spots f.
3. Normal.
4. Nucleus jagged, f. spots in a cluster.
5. Nucleus bridged and elongated.
6. Circular, but nucleus opening centrally.
7. Nucleus trifid.
8. Tapering, penumbra to the N.
9. Nearly circular.
10. Decreasing rapidly.

July. GROUP 154. *Long.* 237° to 228°. *Lat.* 16° to 19° N.

2. A pair of small spots, about two days from E. limb.
3. A stream.
4. Almost a zigzag, the first and last spot much larger; area 260 square seconds.
5. In two sets, inclining in different directions, the first a stream of sharp nuclei, the second with two penumbral spots.
6. The first reduced, consisting of two pairs only, the second still more.
7. A circular spot p., with penumbra to the S. and triple nucleus, three small single spots f. some distance apart.
8. One spot, decreasing rapidly.

July. GROUP 155. *Long.* 191°. *Lat.* 14° S.

2. A small spot near E. limb.
3. Little change.
4. Penumbra on the p. side.
5. A small spot f.
6. Single.
7. A wide pair.
8. Decreasing.
9. A close pair.
10. Two little spots, N. and S. of each other.
11. Very faint.

July. GROUP 156. *Long.* 189° to 180°. *Lat.* 10° to 12° N.

2. A considerable spot close to E. limb at 9 a.m.
3. A small one f.
4. Normal, more spots f.
5. Two of the f. with penumbra.
6. Great increase; a train, leading spot the largest, in length 40″; four with penumbra following besides outliers.
7. Leader with nucleus tapering, the f. more connected but inclined to disintegration and formation of miniature streams.
8. Many minor changes, the leader vertical.
9. Leader with nucleus curving eastward, two penumbral spots f.
10. Leader crescented, penumbra on the p. side, the most f. curved with penumbra in the opposite direction.



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July. GROUP 156—*continued.*

11. Last spot and leader nearly equal, intermediates fast decreasing; some hours later leader more broken up, with a tiny stream of dots issuing from it at the rear.
12. Nucleus of leader trifid, two dots only left of the stream, last spot nearly normal, with dots p.
13. A pair; diminishing, dots almost gone.
14. Leader the larger of the two, with double nucleus, near limb.

July. GROUP 157. *Long.* 178° to 167°. *Lat.* 17° to 20° S.

3. A penumbral spot near E. limb, a smaller one f.
4. Nucleus divided, two spots f. (The same position as the f. part of 134.)
5. Nucleus wavy, a portion to the N. almost severed, one of the f. spots almost normal, a new one to the S.
6. Severed portion reduced to a pair of small nuclei, penumbra, almost confined to the f. side, the most f. spot now the largest, breaking up to the N., with a patch of penumbra as if thrown off, a few small outliers only besides.
7. The p. with one of the small nuclei more distant, the f. as large again, upper portion still disrupted with more small nuclei.
8. The p. still one-sided, a new spot at some distance n. p., the f. normal, more than 1′ in length, nucleus tapering; 10 hours later, bridged in several places and egg-shaped.
9. P. very much reduced, now a close pair, the f. more circular.
10. The pair p. very small, the f. spot vertical, pointed at one end.
11. Signs of disruption in the f., small nuclei bursting forth.
12. The pair gone, the f. more curved and elongated.
13. Broken up at the extremity.
14. More normal, penumbra with a pointed projection to the S.

July GROUP 158. *Long.* 279°. *Lat.* 12° S.

6. A pair of small dark spots at some distance from W. limb. Probably identical with 151.

July. GROUP 159. *Long.* 206° to 199°. *Lat.* 14° to 18° S.

6. A few tiny spots preceding Group 155.
7. In three sets and more in number, the p. spot compound, the rest very diminutive.
8. The p. more circular, nucleus trifid, more dots interposed, forming a little irregular stream.
9. Three principal spots.
10. The p. nearly normal, only one spot f.
11. Little change.
12. Decreasing.

July. GROUP 160. *Long.* 136°. *Lat.* 8° to 13° N.

6. A large spot very near E. limb at 7.45 a.m., a penumbral patch above and a faint spot p.
7. Large spot with two nuclei, the penumbral patch with one, outliers between.
8. The two spots more widely separated with penumbra on opposite sides.
9. The N. spot with more scattered nuclei.
10. The spot to the S. with three nuclei, one very large and dense, a new spot at some distance to the N.
11. The N. spot completely shattered and become a mass of small nuclei, the southerly one fan-shaped, nuclei split up and decreased, radiations from the centre distinct.
12. Penumbra of S. spot closing round the nuclei in a circle, leaving an opening only to the N., a decided change taking place between 9.30 and 10.30, nuclei small and sharp, one only united to the main spot by a dark narrow line, the shattered fragments more dispersed.



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July. GROUP 160—*continued.*

13. Penumbra entirely closed up all round, nuclei still more subdivided and intricate, radiating also from the main spot northwards, with dots encircling the whole on three sides, a very faint stream of them also f.
14. Main spot quite circular, 50″ in diameter; 8° N. lat. the nuclear radiations of yesterday increased and containing more penumbra and many tiny nuclei placed in rows. At 6 p.m. penumbra again splitting to the N., the stream of dots not seen.
15. A great change, main spot with one large elongated nucleus, the rest comparatively few and almost united to it.
17. Small nuclei still decreasing.
18. Near limb, much extended to the N. and S., four principal nuclei.

July. GROUP 161. *Long.* 125°. *Lat.* 10° N.

7. A small penumbral spot f. Group 160. (Position of 137.)
8. Normal, one outlier.
9. Pointed at the extremity.
10. Little change.
11. Dividing to the N., major axis 40″, dots to the S.
12. Nucleus more angular.
13. Nucleus forked and opening to the S.; dots in a tiny stream.
14. Nearly normal, three small outliers.
16. Decreasing, more circular.
17. Little change.
18. Penumbra only to the N.
19. Still smaller.

July. GROUP 162. *Long.* 110°. *Lat.* 10° N.

11. A very small spot f. 161.
12. No change.

July. GROUP 163. *Long* 139°. *Lat* 10° S.

11. A small pair of spots, widely separated, at 8 a.m. Seven hours later more in number, dark, but without penumbra.
12. Further increase, the most p. nearly circular, with a curious crooked nucleus, diameter 30″. The f. spots in a sickle-shaped curve consisting of small nuclei, with slight penumbra.
13. Still increasing. Two penumbral spots, the p. more normal, tapering, the f. wedge shaped, many dots and tiny nuclei scattered between the two.
14. The p. with a portion as it were sliced off, the f. become two spots, the f. more scattered and altered in position, two spots with penumbra.
16. The p. normal, the f. all fragmentary.
17. One spot near limb.

July. GROUP 164. *Long* 103°. *Lat.* 19° S.

11. At 8 a.m. a pair of small spots, increasing at 3 p.m.
12. In a triangle, with a little penumbra.
13. About six in number without penumbra.
14. A few very faint dots.

July. GROUP 165. *Long.* 89°. *Lat.* 11° S.

10. A penumbral spot not far from E limb.
11. Normal.
12. A small spot p.
13. Elongated and inclined to the equator, major axis 30″.
14. Split into three or four little spots, close together, with penumbra to the N.
16. One very faint spot.



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July. GROUP 166. *Long.* 78°. *Lat.* 9° to 14° S.

10. Two penumbral spots N. and S. of each other, very near E. limb at 6.20 p.m. Position of 141.
11. A. (the N. spot) normal, B. (the S. spot) double, a few smaller ones f.
12. The two spots nearly equal. A. with a small portion dissevered. B. with two nuclei, one very large, three penumbral spots f.
13. Each spot with two nuclei, one larger than the other, the f. spots decreasing.
14. A. with a huge dense nucleus, bridged at the extremity, diameter 55″. B. now the larger, diameter 1′, bridged in two places, two small penumbral spots f.
16. A striking pair, both spots tapering and pointing S., with two nuclei, one large and the other very small, a cloud of outliers f.
17. Nuclei of A. and B. nearly at right angles to each other.
18. A. with the pointed end of nucleus curving round westward. B. more pointed at the extremity, and a tail like appendage of dots and fragments.
19. Nucleus of A. curved in the form of a horse-shoe and turned southwards. B. more normal but pointed at both ends, outliers f. in a stream.
20. Again nearly equal. A. more angular, outliers few.
21. A. with nucleus entire. B. blunted at the extremities.
22. Both spots nearly normal.

July. GROUP 167. *Long.* 66°. *Lat.* 12° S.

12. Two penumbral spots, following Group 166, N. and S. of each other.
13. The spot to the S. about 20″ major axis, the one to the N. not seen, but two very small spots p.
14. Much reduced, a miniature cluster of dots p.
16. Dots surrounding.
17. Little change.
18. Elongated, some small outliers p. and f.
19. A wide pair, a tiny cluster of dots f.
20. A stream almost entirely composed of dots.
21. Three dots widely separated and a few nearer Group 166.

July. GROUP 168. *Long.* 55°. *Lat.* 8° N.

12. A spot very near E. limb at 9.30 a.m.
13. Nearly normal.
14. Penumbra wider on the p. side.
16. Great increase, a pear-shaped spot with penumbra only on the p. side; to the S. four nuclei linked together with penumbra, dots and small spots in a semi-circle n. f. A wide pair n. f. at some distance.
17. Outliers to the N. increasing, those to the S. altered in position.
18. A large spot, nucleus forked at the end, some of the spots to the S. confluent with more penumbra; a half-moon shaped spot to the N.
19. Major axis 45″, nucleus enlarged, turning eastward, spots to the S. dwindling and compressed, the half-moon shaped spot dispersed and become a stream of fragments.
20. Outline regular, nucleus in three divisions, the middle one crescented, outliers much diminished.
21. Much broken up with many sharp nuclei.
22. A portion of the N. side severed.
23. Normal; no outliers observed.

July. GROUP 169. *Long.* 58° to 46°. *Lat.* 10° to 12° S.

13. Two spots near E. limb resembling Group 167. Many faculæ to the S.
14. The p. with two nuclei, broken up on the f. side, major axis more than 30″.
16. The p. decreased, the f. now the larger, with pointed nucleus, dots and sputterings in the neighbourhood; three small spots at a distance s.f.
17. The f. spot decreasing, some outliers larger.



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July. GROUP 169.—*continued.*

18. Many spots forming a wide stream, two of the p. only with penumbra, distant spots in a line.
19. Stream no longer double but curved round to the S. More penumbral spots interspersed with nuclei and dots.
20. Apparently two larger spots in course of formation, the rest fewer in number.
21. On the wane, spots more equal in area, with sharp nuclei.
22. Many little spots in a serpentine stream.

July. GROUP 169A. *Long.* 25°. *Lat.* 30° S.

16. Two spots very near E. limb at 5 p.m.
17. A pair, nearly normal.

July. GROUP 170. *Long.* 357°. *Lat.* 13° N.

16. Two spots very near E. limb at 5 p.m. (Position of Group 145.)
17. A pair, nearly normal.
18. The p. with two nuclei.
19. Both normal, a few outliers. (N.B.—Three large double spots now visible at the same time.)
20. Nuclei inclined in different directions. Length, 40″ and 45″.
21. Nuclei elongating and bridges appearing in both, outliers few and small.
22. A small spot in advance.
23. The p. circular.
25. The p. smaller with curved nucleus, the f. with forked nucleus.
26. The p. with penumbra only on the W. side, the f. normal, a few outliers to the N.
27. The p. half the size of the f., with penumbra still westward.
28. The p. very much reduced.
29. The f. close to W. limb at 12.30.

July. GROUP 171. *Long.* 345°. *Lat.* 14° N.

18. Two large spots near E. limb, having nearly the same longitude.
19. A pair, major axis of each about 30″.
20. Nuclei inclined in different directions (as in Group 170).
21. Nuclei in the same direction and closer together, one larger.
22. Almost in contact, a few followers.
23. Contiguous. Area, 1,500 square seconds.
25. Two portions almost severed, with narrow nuclei and penumbra on one side.
26. Again two spots with the same longitude.
27. The N. spot decreasing.
28. Three spots, much reduced, with little penumbra.
29. Near W. limb, one spot only conspicuous.
30. Close to W. limb.

July. GROUP 172. *Long.* 328°. *Lat.* 9° S.

20. A few small spots not far from E. limb.
21. An elliptical group, the leading spot the largest with two curved nuclei.
22. Leader increasing, the f. more in a stream.
23. The f. spots coalescing; area, 1,000 square seconds.
24. Leader with irregular elongated nucleus, the f. faint and small.
26. More circular, the f. few and widely separated.
27. Nucleus divided.
28. Undivided, more quadrangular.
29. Normal.
30. Penumbra rather wider on the p. side and also fainter.
31. Very near W. limb at 9 a.m. Penumbra decidedly wider p.



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July. GROUP 173. *Long.* 301°. *Lat.* 16° N.
21. A medium size spot with the nucleus in the form of a magnet.
22. Little change.
23. Normal.
25. Nucleus jagged, with a black hole in it.
26. Black hole still conspicuous, penumbra forked to the S. Area, 1,212 square seconds.
27. Normal, small nuclei to the S.
28. Circular, three little spots s.p.
29. Much fimbriated, black hole across the centre of nucleus.
30. Nucleus with a process on the f. side, outliers few and very small.
31. Penumbra nearly equal on both sides.
Aug.
1. A little wider on the p. side.
2. Decidedly wider.

July. GROUP 173A. *Long.* 272°. *Lat.* 13° N.
25. A scattered group of very small spots s.f. 173.

July. GROUP 174. *Long.* 281°. *Lat.* 21° S.
23. A normal spot near E. limb.
25. Nucleus sharply fissured to the N., a few small spots f.
26. Nucleus jagged on the W. side.
27. Little change.
28. Nucleus tapering.
29. More angular. Area, 600 square seconds.
30. Signs of breaking up.
31. Nearly normal.
Aug.
1. Little change.
2. Penumbra rather wider nearest the limb.
3. Little change.

July. GROUP 175. *Long.* 222°. *Lat.* 11° S.
29. Two pairs of tiny spots.
30. A few more, further apart.
31. Very small.
Aug.
1. Not seen.
2. Two dark nebulous spots, a smaller one p.

July. GROUP 176. *Long.* 193° to 178°. *Lat.* 6° to 13° N.
29. Two spots near E. limb. Faculæ observed on the 28th. Position of the f. spot of Group 156.
30. A train; two compound spots, the leader with nucleus in a quartrefoil and many outliers.
31. All the spots much disintegrated with small sharp nuclei.
Aug.
1. Leader decreasing, much divided, penumbra only to the S., the f. almost split in twain, with two nuclei in each portion.
2. Leader became two small spots. The f. large and very complicated, with a gap in the middle and many irregular nuclei, the largest showing a difference in tint. A multitude of small spots and dots between, and a few more widely scattered p.
3. Large spot nearly vertical with three principal nuclei, one of them more to the E. than on the 2nd. Mr. Hale White mentions it as abounding in delicacy of detail, impossible to describe, one marking being almost like a hair line, outlying spots altering in form and position.
4. More elongated with a loop to the S. Nuclei decreasing in area and again altered in position, two to the N. nearly equal and parallel, small ones depending below like strings of beads, outliers fewer and much dispersed.



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Aug. GROUP 176—*continued.*

5. Slowly decreasing and breaking up, the nuclei still changing, outliers more numerous and also altered in position; a new stream to the N.
6. Further change and disintegration in the main spot, now more inclined to the equator and with less penumbra, some of the outliers larger, a long stream of dots in a curve s.f. Area, 1,000 square seconds.
7. Main spot more fragmentary on the p. side, a small one to the S. of it vastly increased, with sharp nuclei in a zigzag, a little stream f., distant outliers nearly gone. Area, 1,200 square seconds.
8. Three distinct spots still showing rapid changes. At 4.45 p.m. nuclei much developed.
9. Two principal groupments and two principal spots, one to the S. nearly normal, outliers fewer but larger.
10. Still very compound, outliers decreasing in area.
11. Near W. limb, two conspicuous spots.

July. GROUP 177. *Long.* 175°. *Lat.* 5° N.

30. A pair of small spots f. Group 176, forming part of the same train.
31. The p. double, the f. nuclear, some outliers.

Aug.

1. Two pairs, one spot normal, the others with slight penumbra, no outliers.
2. The p. pair much reduced.
3. The p. gone, the f. broken up into small spots.
4. Two spots, one with penumbræ.

Aug. GROUP 178. *Long.* 145°. *Lat.* 18° N.

2. A spot near E. limb, penumbra on the p. side.
3. Penumbra equal on both sides, one or two small spots and bright faculæ f.
4. Normal, two f. spots.
5. Nucleus tapering, a small portion severed, the f. spots gone.
6. Nucleus bursting out and discharging fragments at the rear. Area, 900 square seconds.
7. Fragments dispersing.
8. Oval, one fragment only left.
9. Normal, nearly circular.
10. Little change.
11. Little change.
12. Little change.
13. Nearing W. limb.

Aug. GROUP 179. *Long.* 142°. *Lat.* 6° N.

2. A small penumbral spot near E. limb.
3. Little change.
4. A few outliers.
5. Decreasing.
6. Two very small spots.

Aug. GROUP 180. *Long.* 146° to 140°. *Lat.* 15° to 13° S.

2. A few little spots, widely separated.
3. No increase in area.
4. One spot.
5. Nearly normal.
6. Breaking up; two dots at some distance to the N.
7. No increase; dots larger.
8. At 9.30. Many small spots and dots p. in an ellipse, a few f. in a triangle. At 4.45 p.m. some of the p. spots larger, more nuclear, and very dark.
9. At 7.45 a.m. a normal spot p., major axis 45″ of arc, a singular compound spot f. with an excess of penumbra. A few outliers.
10. The p. tapering, the f. nearly normal with two nuclei, more outliers.
11. The f. with one nucleus.
12. Each with two nuclei.
13. The f. with three nuclei; a new spot f.
14. Two spots near W. limb, at 9.45 a.m. a bright patch of faculæ f.



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Aug. GROUP 181. *Long.* 163°. *Lat.* 19° S.

1. A small normal spot near E. limb.
2. Two more further S.
3. More outliers p., the spots to the S. gone.
4. Decreasing.
5. Three quite small spots in a triangle.
6. Little change.
7. One spot increased, four dots p. and one f.
8. At 5 p.m. Two tiny pairs in a line. (On the 9th only faculæ.)

Aug. GROUP 182. *Long.* 85°. *Lat.* 12° S.

7. A spot near E. limb, penumbra wider on the p. side.
8. Penumbra rather wider on the f. side. (Nearly the position of 165.)
9. Normal.
10. Little change.
11. Little change.
12. Nucleus double.
13. Nucleus single.
14. Nearly circular.
15. Little change.
16. Decreasing.
17. Penumbra about equal on both sides.
18. Much reduced.

Aug. GROUP 183. *Long.* 71°. *Lat.* 16° S.

7. A spot with slight penumbra, very near E. limb at noon.
8. Little change.
9. Major axis 35″, penumbra a little wider on the f. side.
10. Little change.
11. Very similar to 182.
12. Circular.
13. Somewhat decreasing.
14. Nucleus more angular.
15. Major axis about 20″.
16. Little change.
17. Decreasing.
18. Penumbra a little wider on the p. side.
19. Near limb.

Aug. GROUP 184. *Long.* 80°. *Lat.* 21° S.

7. A very small spot near E. limb.
8. Several.
9. Two; widely separated.
10. A tiny pair n. f.
11. No increase.
12. One spot.

Aug. GROUP 185. *Long.* 15°. *Lat.* 28° S.

15. A pair of very small spots.
16. Another tiny pair f.

Aug. GROUP 186. *Long.* 31° to 20°. *Lat.* 2° to 8° N.

11. Two considerable spots near E. limb.
12. Three compound spots. Area 2,000 square seconds.
13. The three principal spots nearly at right angles to each other, nuclei angular.
14. General outline, as well as component parts, altered; spots confluent, nuclei increasing and curving in opposite directions. Strong reversal of the C line over the larger nuclei.
15. At 10.30 spots still more confluent, showing a vast extent of surface covered with a mass of nuclei and penumbra partially connected and very variable in form. At 1 p.m. the largest nucleus to the S. heliacal, throwing out feelers like a jelly fish. Group inclined to the equator. Area 8,000 square seconds.



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Aug. GROUP 186—*continued.*

16. At 10.50 more disintegrated, two nuclei larger than the rest, the p. with a branch of dazzling white matter and a double stream of small nuclei stretching out to the W. At 3.30 further disintegration; group nearly reaching the central meridian.
17. At 6 p.m. Becoming elongated, spots more in a train, wavy, the large nucleus p. quadrangular, one of the f. pear-shaped and showing a difference in tint, spots at the rear branching.
18. More divided and extended in latitude, three huge spots, the two p. both with a difference of tint in the nuclei, the rest more numerous, still forming a confused fragmentary mass. Area 6,200.
19. Difference in tint still discernible in the large nuclei, smaller constituents decreasing. (Only one observation by Prof. Pereira.)
20. The two large p. spots just in contact and more normal, the rest fast diminishing, their components being more penumbral than nuclear. Area 3,000 square seconds.
21. The two p. spots distinctly separated, the f. still more on the wane.
22. Spots smaller and still more separated, three principal ones.

Aug. GROUP 187. *Long.* 347°. *Lat.* 20° S.

15. A small penumbral spot some distance from E. limb, but not observed on the 14th.
16. Nucleus double.
17. Little change.
18. Penumbra chiefly to the N., a tiny stream of dots closely p. Area, 50 square seconds.
19. Decreasing.
20. Penumbra slight.
21. Little change.
22. Very small and faint.

Aug. GROUP 188. *Long.* 336°. *Lat.* 7° S.

15. A penumbral spot.
16. Penumbra nearly equal on both sides.
17. Normal.
18. Little change.
19. Area, 200 square seconds.
20. Nucleus pear-shaped.
21. No details.
22. Nucleus dividing.
23. Fast decreasing.

Aug. GROUP 189. *Long.* 323°. *Lat.* 26° S.

16. A little pair near E. limb imbedded in faculæ.
17. Hardly any increase, two dots f.
18. Smaller, faculæ still surrounding.

Aug. GROUP 190. *Long.* 298°. *Lat.* 18° N.

17. A penumbral spot; near E. limb at 6 p.m.
18. Penumbra wider on the f. side. A small nucleus detached from the larger one.
19. Small nucleus outside the penumbra.
20. Penumbra wider on the p. side.
21. Little change.
22. Normal.
23. Decreasing.
24. Still smaller.

Aug. GROUP 191. *Long.* 302°. *Lat.* 13° S.

17. A small spot with slight penumbra near E. limb.
18. Nucleus dividing.
19. Area, 20 square seconds. Conspicuous faculæ f.
20. Little change.
21. A pair.
22. Single.



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Aug. GROUP 192. *Long.* 352° to 348°. *Lat.* 6° to 8° N.
20. Three very small spots, the first a pair.
21. The first with a little penumbra.
22. Another very small spot f.

Aug. GROUP 192A. *Long* 20°. *Lat.* 17° S.
21. A small spot at some distance from W. limb.

Aug. GROUP 193. *Long.* 317°. *Lat.* 15° N.
26. A tiny spot and one dot.
27. Two pairs and a few dots, one with slight penumbra.
28. Three spots near W. limb, two of them rather larger.

Aug. GROUP 194. *Long.* 216°. *Lat.* 6° S.
26. A few small penumbral spots in two sets at some distance from E. limb.
27. The leading spot much enlarged with three nuclei, the rest forming a stream.
28. Leader nearly normal, nucleus still divided, three f. spots. Area, 400 square seconds.
29. Many small nuclei in leader, f. spots forming a triangle.
30. Decreasing, only one f. spot.
31. Still on the wane.

Sept.
1. Solitary.
2. Double.
4. Near limb.

Aug. GROUP 195. *Long.* 180° to 174°. *Lat.* 8° to 14° N.
26. A penumbral spot near E. limb preceded by an immense range of faculæ (a return of Group 176).
27. Nucleus two-lobed.
28. Splitting in twain, a few small followers.
29. Entire, the f. increased, forming a triangle with the leader. This also occurred in Group 194 on the same date.
30. More circular, nucleus angular, the f. more numerous but smaller except the final which has increased and become double. At 5.40 p.m. two of the f. spots much larger, also the final.
31. Three principal spots well developed. The final very compound.

Sept.
1. The two leading spots more in a line and becoming normal, the final changing, a penumbral spot to the N. of it, more small outliers.
2. Leaders decreasing but a rapid growth in one of the outliers. The final normal with curved nucleus.
4. Leaders unrecognisable, only three small spots, two of them close pairs, p. The final more abnormal and shorn of nearly all its attendants.
5. One small spot p., the final dwindling and almost alone.
6. The p. gone, the final more reduced.
7. One spot, nearing W. limb.

Aug. GROUP 196. *Long.* 141°. *Lat.* 10° S.
30. A faint spot in the midst of faculæ—a great amount also s. p.
31. Two or three, very small.

Sept. GROUP 197. *Long.* 110° to 103°. *Lat.* 14° to 17° S.
2. Two very faint spots surrounded by faculæ.
4. Both increased especially the most northerly, dots f.
5. The northerly with penumbra and several small nuclei, the southerly only a tiny stream.
6. The northerly dispersing.
7. Three faint little spots, nearly equidistant and a pair.
8. Two spots, very faint.
9. One spot.
10. A close pair.



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Sept. GROUP 198. *Long.* 84°. *Lat.* 30° N.
4. A small spot at some distance from E. limb.
5. Two.
6. Very faint.
7. Little change.
8. Two pairs very widely separated.

Sept. GROUP 199. *Long.* 57°. *Lat.* 8° S.
5. A penumbral spot near E. limb.
6. Penumbra wider to the N.
7. Chiefly confined to the S.
8. More normal, penumbra on the p. side.
9. Elongated and tapering.
10. Broken up at the extremity.
11. Fragmentary.
12. A few little spots in a semi-ellipse, dots f.
13. A miniature stream.

Sept. GROUP 200. *Long.* 142°. *Lat.* 11° S.
6. A scattered cluster of small spots, same position as 196, 24° W. of centre.

Sept. GROUP 201. *Long.* 42°. *Lat.* 17° N.
6. A normal spot near E. limb. Penumbra rather wider on the p. side.
7. Nucleus two-lobed.
8. Pear shaped.
9. Little change.
10. Nucleus oblong, fimbriated, penumbra radiating from it, major axis more than 1′ of arc. A few small followers.
11. Nucleus more circular.
12. Radiations in penumbra still visible.
13. Rather more angular; no outliers.
14. Little change.
15. Pear shaped.
16. Nucleus nearly triangular.
17. Little difference perceptible in the width of penumbra.
18. Very near E. limb at 6.24 p.m. (Azores.)

Sept. GROUP 201A. *Long.* 56° to 52°. *Lat.* 18° to 20° N.
8. A few small spots n. p., Group 201.
9. Rather increased.
10. Two little compact clusters of nuclei.
11. The p. dispersed, chiefly dots, the f. more condensed.
12. The f. only left, decreasing.
13. Smaller.
14. Still smaller.
15. Hardly visible.

Sept. GROUP 202. *Long.* 48° to 36°. *Lat.* 14° to 17°.
6. Two penumbral spots near E. limb following each other.
7. More compound.
8. Enormous increase, a large triangular group consisting of many irregular spots with small nuclei, the first and last the largest.
9. A stream expanding in the middle, spots more in number but decreasing in area, a few detached to the N.
10. Still more numerous, many small sharp nuclei without penumbra, three of the following larger than the rest; none to the N.
11. Less stream-like with two principal centres of activity, the final spot normal.
12. Details much altered, in outline a zigzag, almost entirely composed of small nuclei, the final spot also broken up and merged into some of the p., with irregular wing-shaped penumbral patches. Nearly central.



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Sept. GROUP 202—*continued.*
13. A more complete zigzag, with little streams radiating from it; further change near the extremity. Length 4′ of arc.
14. Nuclei more dispersed, general character retained.
15. Much attenuated in front. A larger spot to the rear.
16. Compounds still small, but more evenly distributed.
17. Much foreshortened.
18. Only the most f. spot visible; faculæ numerous.

Sept. GROUP 203. *Long.* 35°. *Lat.* 9° N.
6. A penumbral spot very near E. limb at 8 a.m., in nearly the same position as Group 186 (rather more in advance).
7. Normal.
8. Nucleus irregular.
9. Penumbra nearly equal on both sides.
10. Nucleus with four divisions; major axis nearly 45″.
11. Breaking up and decreasing.
12. Much reduced.
13. One or two outliers.
14. Still decreasing.

Sept. GROUP 204. *Long.* 39°. *Lat.* 6° N.
7. A small spot s. p., Group 203.
8. Nucleus double; major axis about 15″.
9. Decreasing.
10. Penumbra chiefly confined to the S.
11. Very small.

Sept. GROUP 205. *Long.* 26°. *Lat.* 20° N.
7. An indistinct spot near E. limb.
8. Little change.
9. Decreasing.
10. Little change.

Sept. GROUP 206. *Long.* 156°. *Lat.* 11° N.
8. A few little spots at some distance from E. limb.
9. One spot, rather larger.

Sept. GROUP 207. *Long.* 16°. *Lat.* 12° S.
8. A small spot near E. limb.
9. Little change.
10. Little change.
11. Decreasing.
12. Nebulous.
13. Very small.

Sept. GROUP 208. *Long.* 108° to 105°. *Lat.* 4° S.
9. Three small faint spots.
10. Two, more widely separated.
11. One spot.

Sept. GROUP 209. *Long.* 328°. *Lat.* 11° S.
11. Two very small spots in the midst of faculæ.
12. One faint spot.
13. A little larger.
14. A cluster of small nuclear spots and dots.
15. Two incipient spots, widely separated. Area, 36 square seconds.
16. Record imperfect.
17. Decreasing; area, 18 square seconds.

Sept. GROUP 210. *Long.* 79°. *Lat.* 11° S.
13. A small hazy spot at some distance from E. limb. Position of 182.
14. A little pair, with one following at some distance.



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Sept. GROUP 211. *Long.* 316° to 309°. *Lat.* 7° to 9° S.
13. A penumbral spot near E. limb (A).
14. Penumbra rather wider on the f. side.
15. Penumbra confined to the p. side; a nebulous spot following at some distance (B.).
16. No record.
17. A. preceded by some smaller spots, B. normal.
18. Nucleus of A. broken up; three spots in a row n. p., with slight penumbra. B. circular.
19. A. splitting into fragments, one of the n.p. spots nearly normal, with a double nucleus, apparently two united.
20. B. in two parts, the n. p. with dots streaming from the extremity, major axis 30″. The remains of A. in two sections.
21. The n. p. spot with a portion detached; B. circular, solitary.
22. Two spots nearly similar in area.
23. Both nearly normal.
24. Faculæ numerous.
25. B. near W. limb.

Sept. GROUP 212. *Long.* 345°. *Lat.* 7° S.
15. A little stream.
16. Not seen.
17. About two spots.

Sept. GROUP 213. *Long.* 234°. *Lat.* 19° N.
19. A normal spot near E. limb; a small one following at some distance.
20. Nucleus divided; major axis about 30″.
21. A small portion of the nucleus detached at either end.
22. Normal.
23. Little change.
24. Breaking up at the f. end.
25. A portion detached.
26. Much decreased.
27. Very small.
28. Faint.
29. Little change.

Sept. GROUP 213A. *Long.* 205°. *Lat.* 17° S.
21. A wide pair of small spots.
22. One spot.
23. A pair; area, 20 square seconds.
24. More widely separated.
25. One very small spot.

Sept. GROUP 214. *Long.* 218°. *Lat.* 4° N.
23. Two small spots at some distance from E. limb.
24. Three spots.
25. A cluster.
26. Two spots.

Sept. GROUP 215. *Long.* 121°. *Lat.* 10° N.
27. A normal spot near E. limb, penumbra wider on the p. side.
28. Penumbra nearly equal on both sides.
29. Rather wider on the f. side, a small spot p.
30. Nucleus becoming irregular.

Oct.
1. Major axis about 35″.
2. Circular.
3. No change.
4. The same.
5. The same.
7. Still normal.
8. Penumbra nearly equal on both sides; a light patch in the centre, and signs of disruption.
9. Near W. limb.



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Sept. GROUP 216. *Long.* 227° to 218°. *Lat.* 11° S.
28. A new outburst, two spots apparently in course of formation, differing in long. 7°. A reversal and distortion of the C. line, observed by Mr. Townsend over the most p.
29. The p. enlarged and almost normal, the f. also more condensed but much smaller.
30. The p. normal, the penumbra slightly wider on the f. side, the f. fast decreasing.
Oct.
1. Near W. limb.

Sept. GROUP 217. *Long.* 97°. *Lat.* 14° S.
29. Some irregular spots near E. limb.
30. Smothered in faculæ; increasing.
Oct.
1. A train; many dots and small nuclei, penumbra slight.
2. Increased, the two most f. spots forming a singular pair.
3. Spots in two sets, the pair dispersed.
4. Much decreased.
5. Two small spots.

Sept. GROUP 217A. *Long.* 102°. *Lat.* 10° S.
30. A small penumbral spot following Group 217.
Oct.
1. Penumbra to the S. only.
2. Nucleus curved and dividing.
3. Penumbra on the s.f. side.
4. A sparse cluster of very small spots.
5. Spots in two sets, the upper prolonged equatorially.
7. Two small spots, widely separated.
8. One faint spot.

Sept. GROUP 218. *Long.* 179° to 175°. *Lat.* 8° to 10° N.
30. A cluster of small spots, past the centre of disk (new).
Oct.
1. Hardly more than one spot. Seen by Prof. Pereira on 3rd and 4th.

Oct. GROUP 219. *Long.* 67° to 50°. *Lat.* 8° to 15° S.
1. A spot close to E. limb at noon.
2. A train.
3. Three large spots closely following each other, nuclei much subdivided, penumbra irregular.
4. A wonderful aggregation of nuclei and penumbra intermixed, some of the nuclei with well-defined bridges.
5. Nuclei increased in area, some of the larger in curves.
7. Three principal centres of activity, forms all changing, more small nuclei in streams mixed with dots.
8. Nearly central, leading spot more normal, forked at the extremity, several large nuclei f. but still very compound.
9. Some spots larger, some smaller, but no very radical change.
10. Leader with dense oblong nucleus, the other large nuclei more subdivided.
11. More little streams.
12. The smaller constituents fast disappearing, also the spots in the middle, the first and last only of much importance, the last with six or seven nuclei.
13. Much foreshortened. Penumbra nearly equal to the E. and W. of leading spot.
14. Leader vanished, last spot near but not close to limb at 12 noon.



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Oct. GROUP 220. *Long.* 56°. *Lat.* 13° N.

2. A penumbral spot near E. limb.
3. Nucleus irregular, a vacant space centrally.
4. More normal.
5. Little change.
7. Nucleus bridged in two places, major axis 45″.
8. Nucleus pointed and tail-like at the f. end.
9. More broken up.
10. Little change.
12. More circular.
13. Penumbra nearly equal on both sides.
14. Wider on the p. side.

Oct. GROUP 221. *Long.* 40°. *Lat.* 19° N.

3. A penumbral spot f. 220, nearly same position as 201. A pair of dots between the two.
4. Nucleus double, the p. dots increased, forming a small cluster.
5. Normal, nucleus entire.
7. Circular, major axis 40″. The p. cluster reduced to one spot.
8. Nucleus pointed at the f. end. This was the case with 220 on the same date.
9. Nucleus breaking up.
10. Nucleus jagged.
12. Crescented.
13. Little change.
14. Penumbra nearly equal on both sides.
15. Near W. limb, smaller than when equally distant from E. limb.

Oct. GROUP 222. *Long.* 25° to 16°. *Lat.* 10° to 12° N.

7. A curved stream, the leading spot larger than the others, with a double nucleus. Two groups of dots, observed by Prof. Pereira on the 5th at 6.36 p.m.
8. Leader with nucleus much subdivided, the f. spots more disconnected.
9. Leader with four nuclei, the stream of f. spots markedly concave towards the equator.
10. Leader split up; f. stream less curved, with many small trailing nuclei.
12. Leader circular both as to nucleus and penumbra, the stream wider, nearly parallel to the equator; small nuclei developing.
13. Spots in three sets, leader with trifid nucleus.
14. Decreasing, but more diffused.
15. The last set much disintegrated.
16. Decidedly on the wane.

Oct. GROUP 223. *Long.* 353°. *Lat.* 23° N.

10. A small spot, new, some distance from E. limb, preceded by faculæ on the 9th.
13. Several spots.
13. A stream, one spot increasing.
14. Declining, the largest spot normal, but smaller.
15. Fewer in number.
16. Nearly gone.

Oct. GROUP 224. *Long.* 335°. *Lat.* 8° S.

12. A few indistinct spots 25° E. of the centre of disk.
13. In two sets, very small and widely separated.
14. Three spots. (Prof. Pereira observed two little spots on the 19th in nearly the same position.)

Oct. GROUP 225. *Long.* 15° to 9°. *Lat.* 15° S.

12. Two small spots observed at 6.9 p.m. (Azores.)
13. A nebulous spot, a stream of dots f. (26° E. of centre).
14. Great increase; a leading spot, major axis 30″; a train f., composed of many small nuclei, only a few with penumbra.
15. Leader divided, the f. spots fewer, but larger and more connected.
16. The spots nearly equal in area.



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Oct. GROUP 226. *Long.* 304°. *Lat.* 5° S.
1. A small spot near E. limb, surrounded by faculæ, which the Rev. W. R. Waugh described as appearing to be projected on the limb at 12.30.
18. Increasing.
19. More spots.
20. A stream, the most f. larger and circular, but compound.
21. No drawing.
22. Spots all small.
24. Little change.

Oct. GROUP 227. *Long.* 307°. *Lat.* 12° N.
18. A very small spot, two more f. at some distance.
19. Two spots.

Oct. GROUP 228. *Long.* 210°. *Lat.* 10° N.
19. A small spot not far from E. limb.
20. Penumbra confined to the N.
21. Not drawn.
22. Decreasing.

Oct. GROUP 229. *Long.* 203°. *Lat.* 15° S.
19. A normal spot near E. limb.
20. Circular.
21. No drawing.
22. Nucleus curved, two faint spots f. at some distance.
24. Normal.
25. Major axis 35″.
26. Nucleus more tapering.
27. Decreasing.
28. Penumbra wider on the f. side.
29. Nearing W. limb.

Oct. GROUP 230. *Long.* 204°. *Lat.* 4° N.
22. A few little spots in a stream.
24. One spot.
25. Decreasing.
26. Small, nebulous.
27. Three spots.
28. Rather more.

Oct. GROUP 231. *Long.* 176°. *Lat.* 10° S.
22. A little cluster of very small spots.
24. More diffuse.
25. In a stream.
26. In two sets—a little penumbra.
27. One small spot, two new ones in advance.

Oct. GROUP 232. *Long.* 206°. *Lat.* 11° S.
24. A sparse cluster of small spots.
25. Fewer.
26. Two spots only.

Oct. GROUP 233. *Long.* 165° to 161°. *Lat.* 11° S.
24. About four faint little spots, far apart.
25. Three, forming a triangle, two of them pairs.
26. Two only, nearer each other.

Oct. GROUP 234. *Long.* 143°. *Lat.* 11° S.
25. A nebulous spot 47° E. of centre.
26. Decreasing.
27. Two little pairs.

Oct. GROUP 235. *Long.* 177°. *Lat.* 5° N.
29. A few little spots 35° W. of centre of disk.

Oct. GROUP 236. *Long.* 77°. *Lat.* 14° N.
28. A normal spot, small ones f.
29. Nucleus curved, the f. extending nearly to E. limb.



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Nov. GROUP 236—*continued.*
1. Normal, nucleus double.
2. Nucleus trifid.
3. Nucleus more divided.
4. Tapering.
5. Jagged.
6. Normal.
8. Penumbra nearly equal on both sides.
9. Near W. limb.

Oct. GROUP 237. *Long.* 78° to 60°. *Lat.* 7° to 10° S.
28. A small spot in the midst of faculæ.
29. More, forming a scattered stream. The remains of the train 219.

Nov.
1. Very few.
2. One rather larger.
3. Very small spots in two sets, widely separated.
4. One set almost gone.
5. A tiny cluster. (Dots have appeared and disappeared in this region since the 1st.)

Oct. GROUP 238. *Long.* 162°. *Lat.* 13° S.
29. A small spot 24° W. of centre, another f. at some distance.

Oct. GROUP 239. *Long.* 125°. *Lat.* 15° N.
29. A few little spots and dots about 14° E. of centre.

Nov. GROUP 240. *Long.* 118°. *Lat.* 10° S.
1. Two very small spots.

Nov. GROUP 241. *Long.* 51° to 42°. *Lat.* 7° to 10° N.
1. Two spots f. each other, nearly equal in area, almost normal.
2. The p. smaller. (Position of 220.)
3. The f. with cloven nucleus, a cluster of dots f.
4. The p. with penumbra only to the N. Nucleus of f. curved, major axis 30″.
5. Each with two nuclei.
6. The p. still smaller, more dots and spots f.
8. The p. gone, nucleus of f. bridged. The followers fewer.
9. No radical change.
10. Nearing W. limb.

Nov. GROUP 242. *Long.* 37° to 24°. *Lat.* 10° to 13° S.
2. A small spot near E. limb.
3. About 12 scattered nuclei.
4. The p. forming a cluster.
5. The cluster only seen.
6. Fewer and more in a stream.
8. Great increase, new spots have burst out in advance, four of them considerable, two with streams of small nuclei. Mr. J. S. Townsend observed a strong reversal of the C. line, with his spectroscope, over a tiny cluster to the N., and slight distortion of it in various other places.
9. Three principal centres of activity, the leading spot distinct, the nuclear streams disappearing; the tiny cluster not seen.
10. Spots decreasing in area.
11. All the p. spots quite small, the last nearly normal, with a trail of dots.
12. Near W. limb.

Nov. GROUP 243. *Long.* 350° to 347°. *Lat.* 3° to 5° S.
4. A penumbral spot near E. limb. Faculæ bright, nucleus divided.
5. Nucleus distinctly double (nearly the position of Group 212).
6. Two small spots f.
9. One or two more outliers.
8. Split in two, major axis of each nearly 30″. One spot f.
10. Decreasing in area.
11. One spot only with penumbra.
12. Spots all small, in a curved stream.
13. Four little spots some distance apart, with one much more to the S.
14. One spot only seen.



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Nov. GROUP 244. *Long.* 300° to 292°. *Lat.* 4° to 6° S.
8. A very small spot.
9. Two.
10. A few more in a triangle.
11. Hardly larger than dots.
12. Two little spots further apart.
13. Three.

Nov. GROUP 245. *Long.* 347° to 337°. *Lat.* 22° S.
10. A little stream.
11. The leader and final spot much increased.
12. Leader with penumbra only on the p. side, the final with three nuclei, intermediates small.
13. Leader followed by small nuclei, final compound, major axes 25″ and 30″.
14. Leader broken up.
15. Three spots, the final smaller.
16. One; near W. limb.

Nov. GROUP 246. *Long.* 292° to 287°. *Lat.* 11° N.
10. A few very small spots.
11. A stream, the leader larger than the rest.
12. Little change.
13. Leader broken up on the f. side, major axis 30″; small f. spots altered in position.
14. F. spots fast dwindling.
15. Leader still compound.
16. Decreasing.
17. Much reduced, only two spots f.

Nov. GROUP 247. *Long.* 244°. *Lat.* 9° N.
12. A penumbral spot near E. limb.
13. Nearly normal.
14. Circular.
15. Penumbra s. p.
16. Nucleus divided, major axis 20″.
17. Penumbra slight, two dots f. at a distance.
18. Dark, nebulous, just bridged, two dots wider apart.
19. No penumbra.
20. Decreasing.
21. Very small.
22. More normal.

Nov. GROUP 248. *Long.* 220°. *Lat.* 2° N.
14. A penumbral spot near E. limb.
15. Broken up on the f. side; nucleus double.
16. Nucleus quadruple, small spots f.
17. Nucleus entire, curved; more spots with dots f., one quite distant.
18. More tapering; major axis 30″.
19. The f. spots almost gone.
20. Normal.
21. Penumbra only to the E. and W.
22. Latitude more N. by 3°.
23. Very small.

Nov. GROUP 249. *Long.* 212° to 207°. *Lat.* 13° to 14° S.
17. A few little spots N. and S. of each other. (Nearly the positions of 216.)
18. Larger, very dark, more inclined to the equator.
19. Still more equatorial, two principal spots with several nuclei, penumbra one sided, 5° apart; majoris axes 25″ and 30″.
20. The f. spot broken up.
21. The p. smaller, the f. almost gone.
22. The p. more normal. Distortion of the C. line over faculæ t. the E.
23. Much reduced.
24. Nearly normal.
25. Very insignificant.



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Nov. GROUP 250. *Long.* 155°. *Lat.* 13° S.
18. A very small spot near E. limb.
19. Two f. each other.

Nov. GROUP 251. *Long.* 133°. *Lat.* 9° N.
19. A spot close to E. limb, at 4.48 p.m. (Azores).
20. Nearly normal.
21. Nucleus curved eastward.
22. Small spots f.
23. Penumbra wider on the s. f. side.
24. Normal; f. spots in a stream.
25. Major axis 30″.
27. Little change.
28. No details.
29. Smaller than when central.
30. Little or no penumbra.

Nov. GROUP 252. *Long.* 143°. *Lat.* 10° S.
19. Two very small spots. (In the same positions as 234.)
20. No observations.
21. One spot.

Nov. GROUP 253. *Long.* 190° to 182°. *Lat.* 19° to 22° S.
21. A spot with penumbra only to the S. Smaller ones f. in a curve, a new outburst, not far E. of centre.
22. Leader with several nuclei, the f. spots increasing.
23. Leader still larger, nucleus divided lengthwise, the upper portion elongated, the f. spots forming an ellipse with penumbra chiefly to the exterior.
24. Leader with nucleus undivided, the elongated extremity in course of separation with small nuclei and penumbra curving upwards; major axis 1′ of arc, the ellipse more distant.
25. Leader very fragmentary at the extremity, ellipse compressed.
27. Two principal spots.

Nov. GROUP 254. *Long.* 175°. *Lat.* 11° S.
24. A small normal spot, nearly circular.
25. A pair, no penumbra.

Nov. GROUP 255. *Long.* 150°. *Lat.* 9° S.
23. Two little spots very widely separated, a zigzag of dots between them.
24. One spot, a miniature stream f.
25. Extremely faint.

Nov. GROUP 255A. *Long.* 151°. *Lat.* 7° S.
27. A few very small spots, nearly central.
28. Three in a line.
29. One and a dot.

Nov. GROUP 256. *Long.* 79° to 75°. *Lat.* 10° to 12° N.
28. A sparse cluster of small spots. Seen on the 27th by Prof. Pereira.
29. Fewer, widely separated.
30. One, with slight penumbra.
Dec.
1. A triangular group consisting of small nuclei.
2. The most p. spot larger but with hardly any penumbra.
3. The p. with penumbra on the p. side, f. spots fast decreasing.

Dec. GROUP 256A. *Long.* 89°. *Lat.* 6° S.
1. One or two extremely small spots.
2. One only.
3. Little change.



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Nov. GROUP 257. *Long.* 13° to 8°. *Lat.* 7° to 9° N.

29. A small spot near E. limb.
30. Many faculæ around and f.

Dec.

1. Very small.
2. Increasing in number.
3. Leading spot larger, penumbra on the f. side.
4. A stream, spots more equal in area.
5. Curved, many sharp nuclei, a few with penumbra.
7. The f. spot on the wane.
8. Leader normal, about 30″ major axis, with double nucleus.

Nov. GROUP 258. *Long.* 13° to 5°. *Lat.* 19° S.

29. A penumbral spot near E. limb.
30. Broken up on the f. side, another spot f. nearly equal in area, broken up on the p. side.

Dec.

1. Nuclei of both spots much divided.
2. Leader with a "black hole" dissected by bridges on the s.f. side, penumbral trails adjacent, the f. spot still one-sided, dots in miniature streams p.
3. Leader nearly normal, curved.
4. Tapering, the f. broken up.
5. A rent in the penumbra to the N., major axis 40″. The f. spots small, in a stream.
6. Nucleus curved.
7. F. spots very few.
8. Nucleus again more irregular.
11. Near W. limb.

Dec. GROUP 259. *Long.* 34° to 27°. *Lat.* 12° to 17° S.

1. An elliptical group, a new outburst, with many small spots and sharp nuclei.
2. Immense increase, two spots full of detail and considerable penumbra, several lesser ones between them. Area, 800 square seconds. Three groups visible on this date have a striking resemblance, each having two principal spots very compound in type, the most f. with penumbra only on the E. side.
3. Much extended in longitude, leader with two almost circular nuclei, the final spot more dispersed.
4. Leader tapering, nucleus single, the final broken up.
5. Leader circular, a small portion of the nucleus detached; the f. spots in a wavy line.
6. Nucleus angular, one spot f.
7. Final spot increased.
8. Leader with double nucleus and penumbra s.f., the only f. spot a small pair.

Dec. GROUP 260. *Long.* 355°. *Lat.* 19° S.

1. Two spots f. Group 259, N. and S. of each other, with a little penumbra.
2. A few following.
3. The largest spot normal, circular, diameter 20″.
4. Little change.
5. Penumbra only to the S., more outliers.
6. No details.
7. Outliers fewer.
8. Largest spot much reduced, the rest in a stream.
11. Near W. limb; f. spots fewer.

Dec. GROUP 261. *Long.* 323° to 312°. *Lat.* 2° to 6° S.

3. A few little spots near E. limb.
4. A train.
5. The most p. larger than the rest.
6. Not observed.
7. Not observed.
8. Spots in two sets, small, hazy.



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Dec. GROUP 262. *Long.* 300° to 295°. *Lat.* 2° to 4° N.

5. A spot not far from E. limb, penumbra slight.
6. Not observed.
7.
8. Major axis about 20″, penumbra on the s. p. side.
11. Very small.
12. Two spots, widely separated.
13. A pair.
15. Very faint.

Dec. GROUP 263. *Long.* 332°. *Lat.* 12° N.

8. Two small dark spots widely separated.

Dec. GROUP 264. *Long.* 311° to 301°. *Lat.* 18° to 21° S.

11. New since the 8th, about one day W. of the centre of disk. A fine double train of small spots led by one of considerable size, with two nuclei. Mr. J. S. Townsend observed a reversal of the C. line at different points of the whole length of the group.
12. Leader very complex, opening eastward, major axis 50″. The N. part of the train crowded with little sharp nuclei and irregular patches of penumbra; dots to the S.
13. No details.
15. The leading spot more normal, also the final one, those between much decreased.
16. Near W. limb, one spot in advance followed by several so closely united as to form a singular curve.

Dec. GROUP 265. *Long.* 170° to 159°. *Lat.* 13° to 16° S.

15. A train near E. limb.
16. Spots irregular, about seven with penumbra, the leader the largest.
17. Leader curved eastward, those f. more sub-divided.
18. Nucleus of leader fimbriated, major axis 45″, the f. a wonderful aggregation of small spots with little nuclei and patches of penumbra.
19. Leader tapering, the f. spots more confluent, altered in position with fewer nuclei.
20. Leader cut straight off, as it were, at the f. end, nucleus dense, the f. spots elongated, with nuclei in rows, two at the rear expanded with many dots and sputterings.
21. The f. spots larger but still very fragmentary, positions altered since yesterday.
22. Leader breaking up and curved to the S. Some of the f. more consolidated, but the rest of the train split up into miniature streams, those at the rear now composed of dots and dashes of penumbra.
23. Leader normal, circular, with a narrow tail-like appendage. Two f. spots more definite but very irregular and further from the leader, one of them sharply bridged.
25. Much foreshortened and reduced: the train now quite distinct from the leader, appearing more connected and equalized.

Dec. GROUP 266. *Long.* 147° to 140°. *Lat.* 16° to 18° S.

16. A hazy spot, f. 265.
17. A smaller one to the N.
18. Nucleus double.
19. Little change.
20. Another spot f. at some distance.
21. Nearly normal, the f. dispersed.
22. Nucleus still double, a little stream of dots f.
23. Both nuclei sharply pointed, the stream increased.
25. Much reduced, penumbra only s.f.; the stream with two spots only.
27. One faint spot.

Dec. GROUP 267. *Long.* 199° to 193°. *Lat.* 4° to 6° N.

17. A very small spot about half of sun's radius from centre.
18. Three spots n.f. each other with slight penumbra.
19. One spot and a tiny stream.
20. Fast decreasing.



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Dec. GROUP 268. *Long.* 82°. *Lat.* 8° N.
20. A very faint spot near E. limb, another more distant.
21. Enlarged, signs of division.
22. A pair, nearly equal in area.
23. Spot to the S. the larger.
25. The N. spot the larger.
27. Several little spots with hardly any penumbra.
28. One spot only conspicuous.

Dec. GROUP 269. *Long.* 119°. *Lat.* 13° S.
21. About five very small spots.
22. Little change.
23. Three spots, two of them increased.
25. One only.

Dec. GROUP 270. *Long.* 66° to 58°. *Lat.* 13° to 16° N.
23. A few very small spots.
25. A pair, somewhat resembling 268. One or two f., and three n.f.
27. The f. greatly increased in number.
28. Fewer, four with very dark nuclei almost without penumbra.
29. More in a line, but decreasing in area, positions altered.
30. Smaller.
31. Fewer and more widely separated.

Dec. GROUP 271. *Long.* 32°. *Lat.* 15° S.
25. A small penumbral spot not far from E. limb.
27. Little change.
28. No increase.
29. Nebulous.
30. Decreasing.
31. Two small spots.

Dec. GROUP 272. *Long.* 19°. *Lat.* 16° N.
27. A faint spot at some distance from E. limb.
28. No details.

Dec. GROUP 273. *Long.* 70° to 65°. *Lat.* 4° N.
28. Two small spots S. of Group 270.
29. More; in the form of an ellipse.
30. A stream.
31. Decreasing.

Dec. GROUP 274. *Long.* 346°. *Lat.* 17° N.
28. A penumbral spot near E. limb.
29. Nucleus rather irregular.
30. Nucleus double, penumbra gashed on the f. side with two little patches separated.
31. Penumbra branching on the f. side at 11.20. At 2 p.m. the Rev. F. J. Eld described the spot as semi-circular with two horn-like projections to the penumbra.

Dec. GROUP 275. *Long.* 73°. *Lat.* 19° S.
29. A small nebulous spot W. of the centre of disk.

Dec. GROUP 276. *Long.* 355°. *Lat.* 19° S.
31. Two very small spots and a few dots. (Position of 260.)

Dec. GROUP 277. *Long.* 333°. *Lat.* 7° N.
31. A small dark spot at some distance from E. limb.

Dec. GROUP 278. *Long.* 316°. *Lat.* 12° N.
31. A spot with a little penumbra near E. limb.

Dec. GROUP 279. *Long.* 310°. *Lat.* 17° S.
31. A large normal spot near E. limb. (Position of 264.)



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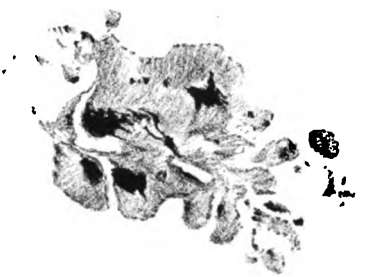
# Group XXII.

Jan: 12

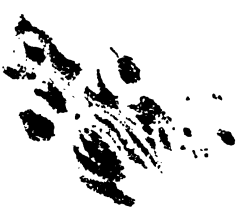
Jan: 14. J. de M. Pereira. del.

Jan: 15.



Jan: 17. E.B. del.

Jan: 18.



Jan. 20. H. Corder del.

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Tuiby & Price lith

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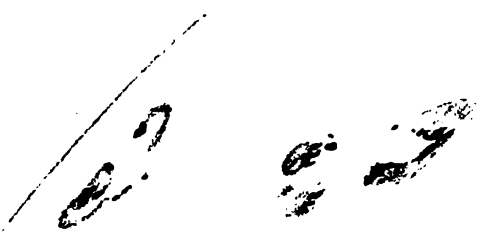
# Group LXXXI.

April 1. E.B. del.

April 3. E.B. del

April 5. E.B. del



April 7. 10.30. $4\frac{1}{2}$in O.G. by Projection. Sun's diam 25in J.de M. Pereira. del.

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Tuilby & Price lith

Digitized by Google

# Group CX.

May 14.

J.de M.Pereira. del.

May 16.9.24.

J.de M.Pereira. del.

May 18. 4.25.

J.de M. Pereira. del.

May 19. 9.20

J.de M. Pereira. del.

Tailby & Price lith

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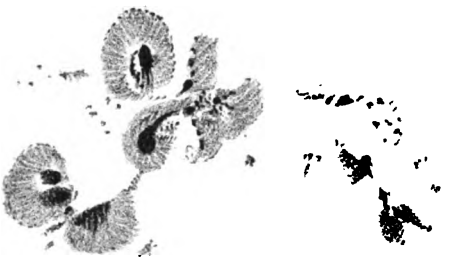
## GROUP CXIII.

May 14. 6.P.M. J.de M.Pereira. del.



May 16.. 9.24. J.de M. Pereira. del.

May 18. 4.15. E.B. del.

May 21. 9.30. E.B. del.

Tealby & Price.lith.

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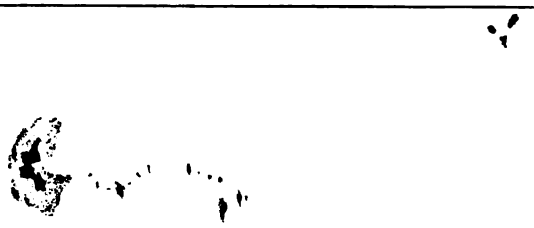
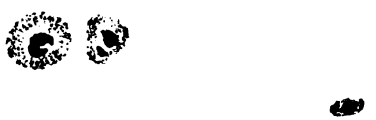
## Group CXXXVII.



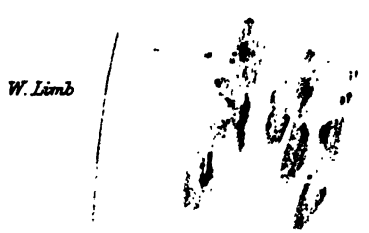
June 12. 10 E.B. del.

June 14. 5.45.P.M. E.B. del.



June 15. 4.30.P.M. E.B. del.

June 19. 10.A.M. E.B. del.




June 21. 8.A.M. E.B. del.

Tailby & Price lith

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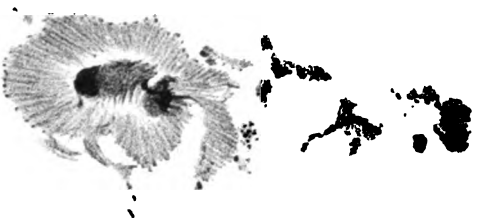
## Group CXLI.

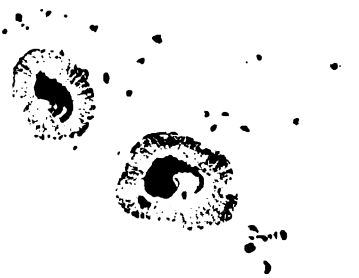


June 18. 6.30. P.M. — J de M. Pereira. del

June. 20. 5.30. P.M. — E. B. del.

## Group CLXVI.

July 13. 5.30. P.M. — E.B. del.



July 16. 5. P.M. — E.B. del.

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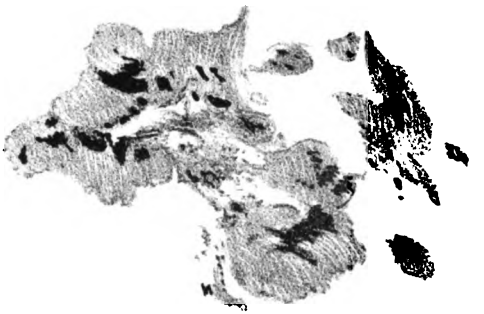
## Group CI.XXXVI



Aug: 15. 10,30. E.B. del.

Aug: 17. 6.P.M. E.B. del.

## Group CCII.

Sep: 12. 4.P.M. E.B. del.

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## Group CCLXIV.

Oct: 4. 12. J de M. Pereira. del.

Oct: 7. 12,30. E.B. del.

## Group CCLXV.

Dec: 20. $3\frac{1}{2}^{in}$ 0.G by Projection. Scale. Sun's image $25^{in}$ E.B. del.

Tailby & Price lith.

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# SECTION FOR THE OBSERVATION

OF

# MARS.

DIRECTOR.—BERNARD E. CAMMELL, F.R.A.S.

## REPORT OF THE SECTION, 1894.

### Introduction.

The following Table gives the alphabetical list of the Members forming the Section, together with particulars of the instruments used:—

TABLE I.

| Name. | Place. | O.G. or Spec. | Aperture in Inches. | Drawings. |
|---|---|---|---|---|
| Antoniadi, E. M. | France | O.G. | $9\frac{3}{4}$ | 12 |
| | | O.G. | $4\frac{1}{4}$ | |
| Baikie, Rev. J., F.R.A.S. | Roxburghshire | O.G. | $3\frac{7}{8}$ | 7 |
| Brown, G. L. | Stirling | Spec. | $10\frac{1}{4}$ | 6 |
| Cammell, Barnard S., F.R.A.S. | Wokingham | Spec. | $12\frac{1}{2}$ | 6 |
| Cottam, Arthur, F.R.A.S. | Watford | Spec. | $12\frac{1}{2}$ | 6 |
| Davis, G. T. | Reading | O.G. | $3\frac{1}{4}$ | 20 |
| Ellis, Henry | London | Spec. | $12\frac{1}{4}$ | 5 |
| Henderson, Arthur | Liverpool | Spec. | $10\frac{1}{2}$ | 7* |
| Kempthorne, Rev. P. H. | Wellington College. | Spec. | $8\frac{1}{2}$ | 7 |
| Maunder, E. W., F.R.A.S. | Greenwich | O.G. | 28 | 5 |
| Mears, T. Willoughby | Brighton | O.G. | $3\frac{1}{4}$ | 5 |
| Mee, Arthur, F.R.A.S. | Cardiff | Spec. | $8\frac{1}{2}$ | 13 |
| Noble, Capt., F.R.A.S. | Sussex | O.G. | $4\frac{1}{2}$ | 5 |
| Patterson, A. Gordon, M.D. | Ascot | Spec. | 10 | 7 |
| Roberts, C. | Bournemouth | Spec. | $6\frac{1}{2}$ | 22 |
| Saul, Rev. R. Beamish | Weston-super-Mare. | Spec. | $8\frac{1}{2}$ | 8 |
| Smart, Dr. D., F.R.A.S. | Bermondsey, S.E. | Spec. | 10 | 1 |
| Stewart, W. C. | York | Spec. | 10 | 1 |
| Taylor, C. A. | London | O.G. | 2 | 6 |
| Waugh, Rev. W. R., F.R.A.S. | Portland | Spec. | $12\frac{1}{2}$ | 3 |
| Williams, A. Stanley, F.R.A.S. | West Brighton | Spec. | $6\frac{1}{2}$ | 8 |
| Wood, J. T. | Nottingham | O.G. | $3\frac{3}{4}$ | 3 |
| | | Spec. | 10 | |

* In addition to eight diagrams, and six drawings of Solis Lacus.



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## TABLE II.

List of drawings made by Members of Mars Section during the opposition of 1894, arranged in order of longitude.

| Longitude of Central Meridian. | Date. | Name of Observer. | Reference to Plates. |
|---|---|---|---|
| ° | | | |
| 0 | Dec. 16 | Wood. | |
| 1 | Oct. 2 | Beamish Saul. | |
| 3 | Aug. 30 | Roberts. | |
| 5 | Sept. 1 | Roberts. | |
| 11 | Dec. 15 | Davis. | |
| 13 | Oct. 1 | Baikie. | |
| 19 | „ 1 | Wood. | |
| 22 | Dec. 18 | Davis. | |
| 25 | Oct. 2 | Mee. | |
| 30 | Aug. 27 | Beamish Saul. | |
| 33 | Sept. 28 | Davis. | |
| 34 | Aug. 27 | Antoniadi. | |
| 35 | Sept. 26 | Roberts. | |
| 35 | „ 27 | Roberts | Plate II., Fig. 7. |
| 35 | Aug. 28 | Roberts. | |
| 38 | Oct. 1 | Henderson. | |
| 43 | Aug. 29 | Roberts. | |
| 47 | Sept. 29 | Ellis. | |
| 49 | Aug. 27 | Antoniadi | Plate II., Fig. 8. |
| 50 | Sept. 29 | Waugh. | |
| 52 | „ 28 | Kempthorne. | |
| 55 | „ 26 | Baikie. | |
| 55 | „ 26 | Kempthorne | Plate II., Fig. 9. |
| 57 | Aug. 23 | Antoniadi | |
| 58 | Sept. 29 | Henderson. | |
| 59 | „ 26 | Davis. | |
| 71 | „ 28 | Henderson | Plate II., Fig. 10. |
| 76 | „ 27 | Cammell | Plate II., Fig. 11. |
| 91 | Oct. 30 | Antoniadi. | |
| 97 | „ 31 | Antoniadi. | |
| 100 | Nov. 1 | Antoniadi | Plate II., Fig. 12. |
| 104 | Sept. 28 | Roberts. | |
| 112 | Oct. 27 | Taylor. | |
| 115 | Sept. 18 | Davis. | |
| 116 | „ 17 | Roberts. | |
| 118 | Aug. 16 | Meares. | |
| 118 | Oct. 27 | Kempthorne. | |
| 130 | Sept. 18 | Davis. | |
| 131 | „ 27 | Roberts | Plate III., Fig. 13. |
| 135 | „ 19 | Mee | Plate III., Fig. 14. |
| 145 | Oct. 23 | Antoniadi. | |
| 153 | Sept. 15 | Antoniadi | Plate III., Fig. 15. |
| 153 | Oct. 25 | Taylor. | |
| 154 | „ 21 | Brown | Plate III., Fig. 16. |
| 157 | Nov. 30 | Beamish Saul | Plate III., Fig. 17. |
| 160 | Oct. 15 | Davis. | |
| 167 | „ 22 | Kempthorne. | |
| 167 | Sept. 14 | Baikie. | |
| 170 | „ 16 | Henderson | Plate III., Fig. 18. |
| 177 | Nov. 25 | Mee. | |



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| Longitude of Central Meridian. | Date. | Name of Observer. | Reference to Plates. |
|---|---|---|---|
| ° | | | |
| 180 | Sept. 12 | Cammell. | |
| 180 | „ 19 | Roberts. | |
| 180 | Oct. 21 | Patterson. | |
| 182 | Nov. 25 | Stanley Williams. | |
| 185 | Sept. 13 | Mee. | |
| 186 | Oct. 14 | Henderson. | |
| 187 | Sept. 11 | Davis. | |
| 190 | Oct. 18 | Brown. | |
| 193 | Sept. 12 | Baikie. | |
| 194 | „ 19 | Stanley Williams. | |
| 197 | „ 11 | Roberts. | |
| 200 | „ 12 | Mee. | |
| 207 | Nov. 25 | Mee. | |
| 210 | Oct. 21 | Patterson. | |
| 210 | „ 21 | Kempthorne. | |
| 213 | Aug. 5 | Antoniadi. | |
| 213 | Sept. 11 | Stanley Williams. | |
| 214 | Oct. 19 | Stanley Williams. | |
| 214 | Sept. 20 | Roberts. | |
| 216 | Oct. 16 | Patterson. | |
| 217 | Sept. 9 | Roberts. | |
| 217 | Oct. 22 | Henderson. | |
| 220 | Sept. 10 | Mee. | |
| 220 | 1895, Jan. 1 | Roberts. | |
| 224 | Sept. 9 | Meares. | |
| 224 | Nov. 18 | Taylor. | |
| 225 | Sept. 7 | Davis. | |
| 226 | Nov. 22 | Brown. | |
| 226 | Oct. 17 | Stanley Williams | Plate IV., Fig. 19. |
| 228 | „ 13 | Waugh. | |
| 228 | July 1 | Antoniadi. | |
| 229 | Sept. 8 | Roberts. | |
| 230 | Oct. 16 | Mee | Plate IV., Fig. 20. |
| 235 | Dec. 27 | Beamish Saul. | |
| 237 | Nov. 19 | Meares. | |
| 240 | Sept. 9 | Stanley Williams. | |
| 240 | Oct. 15 | Stanley Williams. | |
| 240 | „ 16 | Smart. | |
| 241 | Sept. 6 | Roberts. | |
| 242 | Oct. 16 | Davis. | |
| 242 | Sept. 7 | Ellis. | |
| 244 | Nov. 23 | Davis | |
| 244 | Oct. 15 | Patterson. | |
| 250 | „ 16 | Kempthorne | Plate IV., Fig. 21. |
| 252 | „ 14 | Patterson | Plate IV., Fig. 22. |
| 252 | „ 15 | Noble. | |
| 252 | „ 14 | Wood. | |
| 255 | Sept. 6 | Mee. | |
| 255 | Dec. 31 | Davis. | |
| 257 | Oct. 15 | Cammell | Plate IV., Fig. 23. |
| 260 | Nov. 21 | Noble. | |
| 263 | Oct. 12 | Beamish Saul. | |
| 265 | „ 14 | Kempthorne. | |
| 266 | „ 11 | Brown | Plate IV., Fig. 24. |
| 266 | „ 12 | Patterson. | |
| 267 | „ 11 | Baikie. | |
| 275 | Nov. 17 | Davis. | |



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| Longitude of Central Meridian. | Date. | Name of Observer. | Reference to Plates. |
|---|---|---|---|
| ° | | | |
| 276 | Oct. 10 | Baikie | Plate V., Fig. 26. |
| 276 | Sept. 5 | Cammell | Plate V., Fig. 25. |
| 277 | „ 7 | Antoniadi | Plate V., Fig. 27. |
| 283 | „ 5 | Meares. | |
| 285 | Nov. 18 | Mee. | |
| 286 | Sept. 5 | Maunder. | |
| 286 | Dec. 27 | Davis. | |
| 287 | Oct. 8 | Baikie. | |
| 287 | Sept. 1 | Ellis. | |
| 290 | Nov. 18 | Meares. | |
| 293 | „ 18 | Noble. | |
| 293 | Sept. 5 | Maunder | Plate V., Fig. 28. |
| 295 | „ 11 | Roberts. | |
| 296 | Aug. 31 | Davis. | |
| 296 | July 29 | Ellis. | |
| 296 | Nov. 19 | Davis. | |
| 299 | „ 15 | Taylor. | |
| 301 | Oct. 7 | Beamish Saul. | |
| 302 | „ 8 | Noble. | |
| 302 | Sept. 10 | Roberts. | |
| 303 | Oct. 7 | Patterson. | |
| 304 | Nov. 14 | Mee. | |
| 305 | Sept. 4 | Henderson. | |
| 305 | Oct. 8 | Brown | Plate V., Fig. 29. |
| 306 | Dec. 18 | Waugh. | |
| 309 | Oct. 8 | Beamish Saul. | |
| 309 | Aug. 30 | Ellis. | |
| 311 | „ 23 | Davis. | |
| 315 | Oct. 7 | Cammell. | |
| 320 | „ 8 | Mee | Plate V., Fig. 30. |
| 321 | Nov. 15 | Noble. | |
| 328 | Aug. 31 | Maunder. | |
| 329 | „ 29 | Cammell | Plate I., Fig. 1. |
| 330 | Dec. 20 | Beamish Saul. | |
| 330 | Nov. 15 | Beamish Saul. | |
| 340 | Sept. 5 | Roberts. | |
| 341 | Aug. 28 | Antoniadi | Plate I., Fig. 2. |
| 341 | Sept. 6 | Roberts. | |
| 341 | Oct. 2 | Brown | Plate I., Fig. 3. |
| 342 | „ 7 | Taylor. | |
| 343 | Aug. 29 | Maunder | Plate I., Fig. 4. |
| 347 | Nov. 15 | Taylor. | |
| 348 | Aug. 29 | Maunder. | |
| 350 | „ 30 | Roberts | Plate I., Fig. 5. |
| 352 | Oct. 2 | Davis. | |
| 354 | Aug. 30 | Roberts. | |
| 357 | Oct. 2 | Davis. | |
| 358 | Aug. 29 | Stanley Williams | Plate I., Fig. 6. |
| | Nov. 15 | Mee. | |

The Director, in issuing this Report, wishes to convey the thanks of the Members of the Section to Dr. Marth for having so kindly assisted them by forwarding his valuable ephemerides, from which all the longitudes of the drawings have been calculated. Also indirectly to Messrs. Percival Lowell, A. E. Douglas,



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W. E. Pickering, observing at the Lowell Observatory, Arizona, for their valuable and instructive articles and drawings, which have appeared from time to time in "Astronomy and Astro-Physics," also in "Popular Astronomy." To Mr. J. W. Schæberle at the Lick Observatory for his beautiful drawings of the *Solis Lacus* region, to Herr Leo Brenner for his drawings in the "English Mechanic," and last, but not least, to M. Camille Flammarion for his valuable contributions to Areography in "L'Astronomie."

The Director also wishes personally to thank Mr. Maunder for his assistance so kindly given in helping him with his great experience to draw up the list of instructions issued to Members at the commencement of the apparition, and also by placing at his disposal the list of instructions issued by him when Director of the Section in 1892. And also to Mr. Stanley Williams for his most valuable suggestions and criticisms given from time to time. Coming from one who is so well qualified to speak on everything connected with Mars, they have been of great assistance.

The number of drawings sent in amounts to 156. Mr. Henderson, besides, sent in eight diagrams and six drawing of the *Solis Lacus*, and Mr. Stanley Williams eight diagrams, all of which appear in his report.

No doubt a much larger number would have been available had it not been for the very unpropitions state of the weather; in fact, had not the Members been full of enthusiasm and a determination, in spite of the wretched weather, not to let such a favourable opposition of Mars pass without some good work being done, the Director feels that this Report would have been much curtailed.

The Section may be congratulated on having such skilled observers as Mr. Stanley Williams and Mr. Antoniadi among their number. The latter gentleman was fortunate in having at his disposal, during a part of the season, the fine 9¾-in. O.G. of the Juvisy Observatory. The drawings, however, which he made later in the season, and the observations as well, with only a 4¼-in. O.G. are worthy of great praise.

The present apparition of Mars seems to have fully demonstrated the accuracy of Schiaparelli's observations and maps, a large number of his canals and lakes having been seen, and in some instances canals not hitherto recorded. One noteworthy fact, which seems to be well established, is, that during the present apparition certain well known markings on the planet have been either totally obscured or very much altered in form.

The Director begs to thank all the Members for their very willing assistance and co-operation. He wishes that a more experienced observer than himself had been chosen for the post of Director, as he can only claim to be comparatively a beginner in the study of Mars.

He trusts that any shortcomings on his part will be kindly considered.

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## Syrtis Minor.

This sea has been drawn unusually large by a great many observers. The smallest instruments have not failed to show this. In fact, in many cases it might easily be mistaken for the *Syrtis Major*.

In the preliminary report issued in Vol. V., No. 3, of the "Journal of the British Astronomical Association" on the work of the Section, attention was called to this point. There seems now to be no doubt that this great enlargement of the *Syrtis Minor* was due to the enormous proportions which the *Canal Amenthes*, leading out of it, assumed. Most of the observers call this canal the *Lethes*, but after due consideration, there appears to be little doubt that it was the *Amenthes* (*see* preliminary report referred to above). It is also remarkable that this extraordinary increase in size of this canal should have taken place about the same time as the "great cloud formation" over *Mare Cimmerium* and Herschel I. Continent did, namely in October. Also that the *Syrtis Minor* should have begun to regain its normal appearance about the same time as the *Mare Cimmerium*. This point is discussed by Mr. Stanley Williams in his report.

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## Solis Lacus and neighbouring Region.

The dark spot, *Solis Lacus*, received much attention during the Opposition of 1894. *Mr. Henderson* made several observations of it, and sent six diagrams to illustrate the changes it underwent.

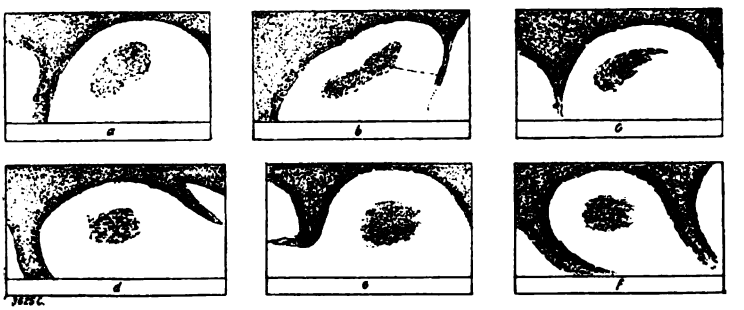
Fig. *a.*, August 22, mere faint diffuse blur; N. of this a reddish-yellow shading which is much duller further N.

Fig. *b.*, September 27, elongated S.E. to N.W., and narrower in the middle portion. *Eosphorus* strongly suspected. *Thaumasia* very bright, where it borders *Mare Erythræum*; the northern portion much duller.

Fig. *c.*, September 28, faint, slightly elongated, narrower towards the E.

Fig. *d.*, September 29, faint, almost round; N. of this a pronounced red tinge as observed before.

Fig. *e.*, October 1, very vague, circular; red tint to N. again prominent.



Changes in the *Solis Lacus*, 1894. (Henderson.)



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*Mr. Cammell*, *Mr. Stanley Williams*, *Mr. Antoniadi*, and *Mr. Henderson*, all report the *Solis Lacus* as appearing elongated E. to W., although the latter on several occasions reports it as circular.

*Mr. Antoniadi* reports, October 30, *Solis Lacus* central, exceedingly dark, almost black.

The *Aonius Sinus* seems to have been very faint, indeed at times invisible. There is no doubt that the appearance here was quite abnormal. All the above observers agree in this, Mr. Henderson, in two drawings of this region, September 29 and September 28, giving no sign of it. Both Mr. Stanley Williams and Mr. Antoniadi about the same time report that it is either wholly or nearly obscured. This has also since been confirmed by some of the American observers. Herr Leo Brenner, on the other hand, a great many of whose drawings have lately appeared in the "English Mechanic," always draws the *Solis Lacus* circular, and the *Aonius Sinus* quite distinct, as it appears in Schiaparelli's maps. This disappearance was no doubt due to cloud. (*See* remarks on this region in preliminary report).

The Director had noticed about the same date that the *Solis Lacus* appeared nearer the p. end of *Thaumasia*, and this no doubt might be accounted for by the *Aonius Sinus* being absent, thereby giving it the appearance of being situated nearer the p. end.

But on careful examination of the drawings to hand, and also from some remarks by Mr. Antoniadi (in "L'Astronomie," November 1894, p. 410) and by Mr. Lowell (in "Astronomy and Astro-Physics," October 1894, p. 650), it appears that the region called by Schiaparelli "*Aurea Chersonesus*" has partially if not wholly vanished. If the drawings of this apparition are compared with those of Green in 1877, and also with those of Schiaparelli, it seems impossible to avoid the conclusion that a large part of the continent bordering on *Auroræ Sinus* has disappeared, and it would, therefore, tend to make the *Solis Lacus* appear out of the centre of *Thaumasia*. Indeed it would actually be so.

Some drawings by Prof. Holden with the Lick telescope, published in the "Publications of the Astronomical Society of the Pacific," show *Thaumasia* extremely narrow on the preceding side.

Herr Leo Brenner, however, shows the lake situated as usual in the centre of *Thaumasia*.

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## Syrtis Major.

The Rev. W. R. Waugh, on December 18, and J. T. Wood on October 14, both show a small bay, extending into *Aeria*, on the f. side of the *Syrtis Major*, at a point where the *Typhon Canal* debouches. Something similar, although not quite the same, was drawn by Green in 1877.

Mr. Wood shows this bay dark and large.

The Rev. W. R. Waugh shows it smaller and fainter.

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### Mare Cimmerium.

During October the *Mare Cimmerium* and a large part of *Herschel I.* continent presented quite an unusual appearance; many observers reporting the *Mare Cimmerium* as quite blotted out, while others again, in attempting to draw this region, report that they were quite unable to satisfactorily identify any of the markings.

There can be very little doubt that those abnormal appearances of the *Mare Cimmerium* and neighbourhood were due to the presence of cloud on Mars.

There seems too, from comparison of the different observations and drawings made about this time, to have been partial openings or thinning of the cloud envelope, especially about the f. end of the *Mare Cimmerium*.

Thus the *Rev. P. H. Kempthorne*, under date October 16, gives the *Mare Cimmerium* as having vanished all but a fragment at the f. end; and on October 22, *Mare Cimmerium* invisible.

*Dr. Gordon Paterson* gives the *Mare* absent under date October 14, faint October 15, the middle portion absent on October 21, and the rest very indistinct.

*Mr. J. T. Wood*, on October 14, and *Dr. Smart*, on October 16, also concur as to the disappearance of the *Mare*.

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### Satellites.

No observations of these minute bodies have been recorded, although one or two observers have suspected faint points of light. When we hear of these most difficult objects being seen at the Manora Observatory by Herr Brenner, with a 7-in. O.G., without even especially looking for them, or taking any means to hide the glare of the planet, in fact being seen quite easily, it appears or might be considered rather a curious circumstance that none of the instruments of the Members of the Section, with the exception, of course, of the 28-in. refractor used by Mr. Maunder, have been equally fortunate in detecting them.

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### The Weather.

*Mr. Cammell* (Wokingham) remarks, that "such a wretched "autumn for astronomical observations could hardly be con- "ceived; in most parts of the country the heavens were obscured "for weeks together by a high bank of clouds, which completely "shrouded the sun by day and the stars by night. Definition, "which in the early part of the season had at times been fair, "seemed in the late autumn to get worse, and night after "night the appearance of Mars suggested a boiling mass of red "light."

*Mr. Maunder* (Greenwich) writes on September 26, "Image "boiling furiously, the planet very bright, but merely a great "flaring naphtha lamp. It was hopeless to attempt a sketch."

*Mr. Mee* (Cardiff) remarks that "definition was never first- "rate, whilst between October 16 and November 14 the



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"atmospheric conditions were so bad as to render all seeing "hopeless."

*Mr. Davis* (Reading) speaks of the definition on October 2 as very good, and that the details were seen like a picture.

*Mr. Antoniadi*, observing at Juvisy, France, was favoured with much better weather, and speaks of "Very fine seeing" on August 5, "Very fine weather" on August 27 and 28, and on September 15 "the air is very calm and steady." His last remark on the weather is, on November 1, "Beautiful definition."

## Colours of Mars.

There is a general agreement amongst the various observers in their remarks on the colours of Mars. All describe the larger continents as more or less orange in tone, and the seas as blue or gray blue, some of them slightly greenish, but, from the bright orange or pink of *Hellas*, to the dusky orange, and faint red grays of other portions of supposed land, there is no great difference in the reports of colour. Mr. Cammell's words are these: "On August 30, 1894, Beer continent—orange and bright "orange. October 7, *Syrtis Major*, beautiful blue gray, the darker "seas a beautiful greenish blue of great purity, very difficult to "imitate. On November 19, *Hellas* was bright orange when on "central meridian."

*Mr. Mee* describes *Hellas* on the 14th November as fiery red, but on the 16th October as colourless.

*Mr. Maunder* writes on August 29, that Beer continent was the reddest region visible, and was of a full orange, and describes the seas as a natural gray, the *Sinus Sabæus* being the darkest.

*Mr. Davis* observed *Hellas* white on the 2nd October and afterwards always ruddy, but the continental regions lost their rosy red tint after the end of November.

*Mr. Wood* reports colours of continents a decided pink, and the dark blue black or blue gray.

*Mr. Roberts* saw on September 19 "a very marked green tint "on the *Mare Cimmerium*."

## Changes of Colour.

As in former oppositions, there is a general agreement amongst observers that certain districts change colour as they pass from the central meridian to the terminator. Especially is this the case with regard to the very distinct marking *Hellas* (Lockyer Land). When fully presented, it is, perhaps, the ruddiest region on the planet; when on the terminator it becomes white, sometimes brilliantly so.

On this point the report of the Director, *Mr. Cammell*, may be quoted. "The larger islands in the southern hemisphere, such as *Hellas*, *Argyre*, and *Noachis*, &c., are often a dull greyish orange, but when near the limb are very bright." The following



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are detailed observations:—*Hellas*, August 29, very bright, near terminator; August 30, less bright, more on disk; October 7, dull orange; October 15, near limb, rather bright; November 19, bright orange, on central meridian. *Argyre*, August 26, a whitish patch; September 27, dull orange; October 7, dull orange. *Noachis*, August 26, a whitish patch; August 31, dull greyish orange; October 7, dull orange.

*Mr. Mee's* observations also supply the following notes with regard to *Hellas*:—*Hellas*, October 7, ill-defined, reddish; October 8, ruddy, smaller than usually drawn; October 12, apparently joined *Ausonia*; October 16, colourless; November 14, very red; November 15, less red when near terminator.

So *Mr. Davis* also reports *Hellas* white and bright on the terminator on September 26 and 28, but later on, in observations at the latter end of October, he mentions that *Hellas* then always appeared ruddy.

## The South Polar Cap.

*Mr. Cammell* observes that the rapid decrease in the size of this cap has been well noted. By the end of October it had practically disappeared. No rifts or outstanding points of light similar to those seen by Mr. Green in 1877 have been observed, but nearly all the Members of the Section have recorded the existence of a dark zone or belt surrounding the cap, and some Members mention that on occasions the cap seemed to extend beyond the limb.

*Mr. Antoniadi* writes on July 1, "S. polar cap is very "white and of enormous dimensions, occupying at least 40° "areocentric arc, and on November 1 it was glimpsed as a small "white speck separated from the limb."

*Mr. Henderson* describes the polar cap as very brilliant, August 22.

*Mr. Maunder* remarks that on September 5 the cap was very small and difficult to see.

*Mr. Mee*, that the cap was very bright between September 19 and October 12, after which it was not observed.

*Mr. Henderson*, on September 29, describes the S. polar cap as "vivid and very large, and on October 1 seeming to project "beyond the limb."

*Mr. Antoniadi* reports, on October 23, no south polar cap visible.

*Mr. Davis* says that the S. pole diminished up to October 2, and was not observed again till December 31. He considers that the cap lies towards 60°.

## The North Polar Cap.

*Mr. Mee* speaks of a whitish region towards the north pole on October 2.

*Mr. Cammell* reports that this cap was visible on December 1 as a brilliant arc of light.



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## White Spots.

*Mr. Cammell* remarks that, in addition to those recorded in the preliminary Report, white spots have been observed on the terminator by Mr. Waugh, and on December 18 two were seen; one, at about 50° S. latitude, would be situated on the following end of *Argyre*, this spot seemed a narrow streak with a small speck of light, S. of it, and separated from it. On the same night another white spot was suspected at about 20° N. latitude, which would be about the northern end of *Chryse*. On January 1st a small white speck was seen about 65° S. latitude, and on same night a similar spot in the northern hemisphere about latitude 50°.

On January 7, a bright spot was seen on the following end of *Thyle I.*

A careful note of a similar spot and projection will be found in the commencement of Mr. Williams' report.

*Mr. Henderson* describes, on September 4, a very bright spot on terminator, N. latitude about 15°, almost appearing to protrude into unilluminated portion. "Can this be *Nix Atlantica*"? Also, on September 10, some very confused light patches on western terminator.

*Mr. Waugh* reports, on September 19, a very bright patch N.E. of cap, as if cloud; and on September 29, a similar patch on S.W. On October 13, three irregular white markings in the southern portion of disk, and on November 19, two bright spots on the terminator; seen again on December 18 and January 1.

*Mr. Roberts* reports, on September 6, a bright spot on *Ausonia*, and on either side of S. end of *Euphrates*, and on September 9, three others visible.

*Mr. Henderson* writes on October 14, $12^h$, 186°. The cloud-like white patches to-night have quite prevented the identification of the markings. October 21, $11^h$, 214°. The details blurred out of all identity. October 22, 217°. Details hard to identify through the light patches. With regard to these observations of Mr. Henderson, the Director, *Mr. Cammell*, remarks, "the three "observations above are worthy of attention, as at this period "that portion of the planet which would come well into view "under the longitudes given was very much obscured by cloud."

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## List of Canals and Observers.

(*When* D *follows a name that observer saw it double, or suspected it to be so.*)

| | |
|---|---|
| *Aethiops* - - | Roberts. |
| *Agathodæmon* - | Antoniadi, Cammell, Kempthorne, Roberts, Williams, D. |
| *Alpheus* - - | Antoniadi, Baikie, Cammell, Williams. |
| *Ambrosia* - | Antoniadi. |
| *Amenthes* - | Baikie, Cammell, Smart, Williams, D. |



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| | |
|---|---|
| *Anubis* | Cammell. |
| *Araxes* | Antoniadi, Cammell, Roberts, Williams, D. |
| *Astaboras* | Cammell, Roberts. |
| *Astapus* | Antoniadi, Cammell, Henderson, Williams. |
| *Astusapes* | Antoniadi, Cammell. |
| *Cerberus* | Antoniadi, Brown, Cammell, Roberts, Williams, D. |
| *Charontes* | Brown, Cammell, Saul. |
| *Chrysorrhoas* | Antoniadi, Kempthorne, Williams, D. |
| *Cyclops* | Antoniadi, Brown, Williams, D. |
| *Dardanus* | Roberts. |
| *Deuteronilus* | Roberts. |
| *Eosphorus* | Antoniadi, Henderson, sus. D. |
| *Eumenides* | Antoniadi, Williams, D. |
| *Eunostos* I | Roberts, Williams, D. |
| *Euphrates* | Antoniadi, Cammell, Roberts. |
| *Euripus* | Antoniadi. |
| *Fortunæ* | Antoniadi. |
| *Ganges* | Antoniadi, Cammell, Kempthorne, Mee, Roberts, Williams, D. |
| *Gehon* | Antoniadi, Cammell, Roberts, Saul, Williams, D. |
| *Gigas* | Antoniadi, Brown, Cammell, sus. D. Roberts, Saul. |
| *Hercules* | Antoniadi, Cammell. |
| *Hiddekel* | Antoniadi, Brown, Cammell, Roberts. |
| *Hydaspes* | Roberts. |
| *Hydrastes* | Antoniadi, Roberts, Williams, D. |
| *Indus* | Antoniadi, Brown, Henderson, Roberts. |
| *Iris* | Roberts. |
| *Jamuna* | Antoniadi, D. Cammell, D. Henderson, Kempthorne, Roberts, D. Saul Williams. |
| *Lethes* | Antoniadi, Baikie, Kempthorne, Roberts, Saul, Williams. |
| *Læstrygon* | Antoniadi, Brown, Saul. |
| *Nectar* | Antoniadi, Kempthorne, Williams. |
| *Nepenthes* | Antoniadi, Cammell, Henderson, Williams. |
| *Orcus* | Antoniadi, Brown, D. Roberts, Williams, sus. D. |
| *Orontes* | Antoniadi, Brown, D. Cammell, Patterson, Roberts, Williams. |
| *Oxus* | Roberts. |
| *Peneus* | Antoniadi, Williams. |
| *Phasis* | Antoniadi, Cammell, Henderson, Roberts, Williams. |
| *Phison* | Antoniadi, Roberts, Williams. |
| *Phlegethon* | Roberts. |
| *Pyrophlethon* | Antoniadi. |
| *Sirenum* | Antoniadi, Brown, Cammell, sus. D. Roberts. |
| *Tartarus* | Antoniadi, Brown, Cammell, Roberts. |
| *Thoth* | Williams. |
| *Titan* | Antoniadi, Brown, Henderson, Roberts, Saul, Williams, D. |
| *Triton* | Cammell, Roberts, Williams. |



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*Typhon* - - Cammell, Maunder, Patterson, Saul, Wood.
*Typhonius* - Antoniadi, Brown, D. Williams.
*Uranius* - - Antoniadi, Cammell, sus. D.
*Xanthus* - - Antoniadi, Patterson, Roberts.

The Director, Mr. Cammell, remarks that the number of canals seen was 27. The *Jamuna* was the only canal distinctly seen double, *Gehon* and the *Ganges* were suspected double. *Anubis*, *Astusapus*, and *Astaboras* were seen as one shaded patch. The canals were never seen very sharp or dark with the exception of the *Ganges*, which on several occasions was almost black.

Mr. Roberts speaks of the markings being hard and sharply defined when definition was good.

Mr. Antoniadi, after enumerating 42 canals, mentions a new canal, seen on November 1, not figured by Schiaparelli, but seen by the Lick observers in 1892.

The most exact observations of the canals are by Mr. Stanley Williams. His report is printed in full.

### Report of A. Stanley Williams, F.R.A.S.

The telescope employed was a 6½-in. Calver reflector, the usual powers being 225 and 320. Place; West Brighton, Sussex.

*Irregularities of the Terminator.*—On three occasions irregularities were noticed at the terminator of the planet when in phase. As these irregularities have been exciting considerable attention lately, it may be as well to give the observations relating to them pretty fully.

(*a.*) 1894, August 18, $13^h\ 20^m$ G.M.T.—A brilliant little projection was observed at the terminator, its appearance and approximate position relative to the S. polar cap being as shown in Fig. A. The bright little arm projected obliquely with respect

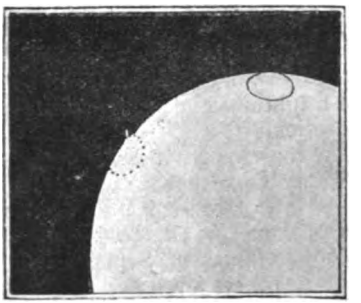

Fig. A. 1894, Aug. 18, $13^h\ 20^m$.
Bright projection on the terminator of Mars.

to the line of the terminator, and the surface adjacent to it just within the terminator was also bright. Cloud coming up almost directly, rendered it impossible to fix the position of this projection with any exactness. It was probably situated somewhere about the south part of *Argyre*.

(*b.*) 1894, August 29, $12^h$ to $17^h$.—The curve of the terminator was distinctly not regular on this night, though no projections



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could be seen. In particular, at one time, when the *Syrtis Major* must have been upon the terminator and just passing off the disk, the limb at this place seemed distinctly flattened. This could not have been an effect of contrast, for none of the dark surface of the *Syrtis Major* could then be seen, the bright continental region *Aeria* apparently extending right up to the limb.

(*c*.) 1894, September 6, $12^h\ 7^m$.—A minute bright projection was visible at the terminator. At $12^h\ 23^m$ its position angle, measured by the micrometer from the apparent centre of the illuminated disk was $243°{\cdot}4$.

$12^h\ 37^m$.—The projection seemed more difficult. Besides being very bright, it was very white. It distinctly projected beyond the terminator, almost at right angles to it, but with a slight inclination towards the south. There was a small very white spot just within the terminator, from which the projection seemed to start. *See* Fig. B.

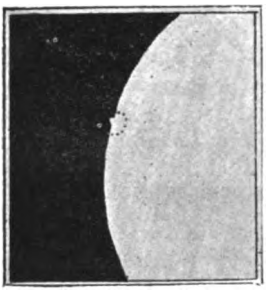

Fig. B. 1894, Sept. 6, $12^h\ 23^m$.
Bright projection on the terminator of Mars.

$12^h\ 46^m$.—The projection could still be seen. The S. coast of Hesperia pointed just south of it. Hesperia seemed to go right up to the white spot at the base of the projection.

$13^h\ 3^m$.—The projection could no longer be seen, though there was still a slight brightness and whiteness at the terminator, at the place of the projection.

September 7 proved cloudy, whilst on the 8th definition was too poor for delicate observations. The projection was suspected feebly at times. On September 9 the seeing was very fair, and a careful watch was kept for the projection at the time corresponding to the observations of September 6, but no trace of it could be seen, nor was there even any white spot visible at the terminator.

The invisibility of either the white spot within the terminator or of the projection on September 9, seems to indicate that the latter was due to a mass of cloud, and not to any actual permanent irregularity at the surface of Mars. This is rendered more probable from the circumstance that this region of the planet was undoubtedly densely obscured by cloud in October.

*Syrtis Minor*.—This region, selected by Mr. Cammell as one of the points requiring special attention, proved in 1894 the scene of some very extraordinary changes.



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In September the *Syrtis Minor* was very well-defined, but seemed to be about in a normal state, as shown in Schiaparelli's map. The canals *Lethes* and *Amenthes*, which fall into it, were seen, but they were not conspicuous. When, however, this region came under observation again in October, the *Amenthes* had assumed enormous proportions, so as quite to alter the appearance of this part of the planet, as will be seen from the following observations:—

1894, October 12, $9^h$ $40^m$ to $9^h$ $50^m$.—Cloud nearly continuous, so that only a few glimpses could be obtained. The *Syrtis Minor* was continued northward by a very prominent canal (*Amenthes*), which appeared to be double as roughly shown in Fig. C. The

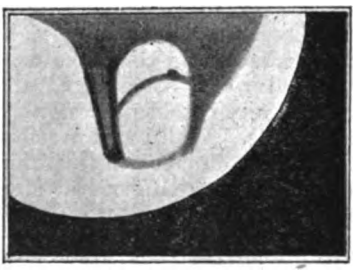

Fig. C. *Syrtis Minor*.—1894, Oct. 12, $9^h$ $40^m$.

duplicity of this canal was of the kind termed "anomalous" by Schiaparelli, the component streaks not being parallel, but wider apart on the south. The space between the two streaks was also strongly dark. The canal *Nepenthes* appeared extremely dark and definite, like a line ruled with pen and ink.

October 14, $10^h$ $10^m$ to $10^h$ $45^m$. The appearance on this night is shown in Fig. D, in which *a* = *Mare Cimmerium* with a darker

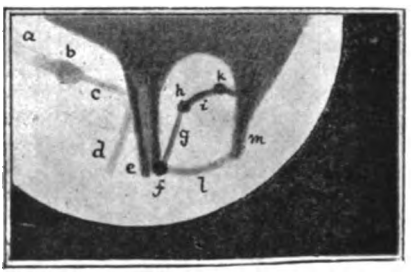


Fig. D. *Syrtis Minor*.—1894, Oct. 14, $10^h$ $45^m$.

spot *b* at its f. end, *c* = *Triton*, *d* = *Lethes*, *e* = *Amenthes*, *f* a minute dark spot or lake, *g* = *Thoth*, *h* = *Lacus Tritonis*, *i* = *Nepenthes*, *k* = *Lacus Mœris*, *l* = *Astapus* (or *Boreosyrtis?*), *m* = *Syrtis Major*. The *Lethes*, however, was not quite certain.

October 15, $9^h$ $45^m$ to $10^h$ $15^m$. The *Amenthes* was seen as a very broad, very dark, well defined streak, and was plainly double,



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much as on the 14th, with the *Thoth* narrow, dark, and definite. At $11^h\ 50^m$ *Lethes* was seen going off at a slight angle to the double *Amenthes* to a faint dark spot, which was probably *Hephæstus*.

October 16, $10^h\ 15^m$. Although def. was bad the *Amenthes* was seen double.

At its third apparition in November the *Syrtis Minor* region had nearly regained its normal aspect. On several occasions the *Amenthes* was visible, but it was feeble and inconspicuous. Only upon one night (November 21, $10^h\ 0^m$) it was described as appearing broad and dark, and perhaps double. In considering the probable cause of such extraordinary changes, it is important to bear in mind that in October, when the abnormal variations occurred, the whole region to the E. of *Syrtis Minor* was evidently more or less thickly obscured or affected by cloud. And, as Mr. Maunder has pointed out in his article on the Canals of Mars in the November number of "Knowledge," the presence of cloud might easily produce very considerable *apparent* changes simply by altering the contrasts. Whilst in November, when the clouds had nearly if not entirely disappeared from this part of the planet, the region about the *Syrtis Minor* had also resumed in great measure its normal aspect.

*Atlantis*.—The curious narrow bright streak thus named in Schiaparelli's map was well seen upon several nights, though on September 19 at $15^h\ 40^m$ it was incomplete, the westernmost half only being visible. Atlantis has always appeared most conspicuous when close to the preceding limb of Mars. This was particularly the case in November 1894, when the Martian atmosphere seems to have been exceptionally clear over this part of the planet. The appearance as seen on November 23 at $9^h\ 45^m$ is shown in Fig. E, Atlantis being broad and remarkably bright and well defined.

Fig. E. *Atlantis*.—1894, Nov. 23, $9^h\ 45^m$.

*Hellas*.—The canal *Alpheus* traversing this island from N. to S. was often visible, the other canal, *Peneus*, being less frequently seen. Only upon rare occasions were both canals visible together. Upon several nights a small dark spot or lake was also observed



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in the middle of *Hellas*, at the point of intersection of these two canals. On one or two occasions the preceding mouth of the *Peneus* appeared bell-shaped. Fig. F. represents the appearance

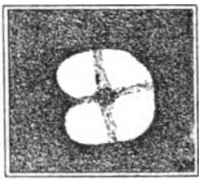

Fig. F. *Hellas.*—1894, Nov. 16.

of *Hellas* as seen on November 16 during a few glimpses through nearly continuous cloud. On this night, contrary to its usual custom, the *Peneus* was more easily seen than the *Alpheus*.

*Canals.*—About 60 canals were observed in 1894, including most of those shown on Schiaparelli's map that are situate S. of N. lat. 30°. The most remarkable instance of invisibility of a known canal occurred in the case of the *Hydaspes*. Although often looked for, not the slightest trace of this canal could ever be seen. The canals seen differed greatly in their appearance from one another. Indeed, it may be said that no two of them were exactly alike. Some appeared as narrow, very definite streaks, so dark as to appear almost black, and nearly uniform in width. *Phison*, *Orontes*, *Typhonius*, and *Nepenthes* were of this appearance. The last-named, as seen in October, bore considerable resemblance to the Cassini division of Saturn's ring when well open, on account of its curved form, and probably was not very much more difficult to see. Others, whilst retaining the blackness and definiteness of the former class of canals, had yet considerable breadth. As instances, *Nectar* and that part of *Agathodæmon* which runs in a s.p. direction from *Lacus Tithonius* may be mentioned. A third kind appeared as a more or less faint, indefinite, and often obviously irregular streak. This was, in fact, the appearance of the *average* canal as seen in 1894.* They were of very various degrees of breadth, ranging from broad, diffuse bands, like the *Ganges*, to mere lines of no visible breadth. Most of these canals, when observed under favourable circumstances, were obviously irregular on the edges and of uneven intensity. Thirteen canals were seen double in 1894. As everything connected with the duplication of the canals is of special importance, the details concerning them are given below.

*Agathodæmon.*—See under *Solis Lacus*.

*Amenthes.*—See under *Syrtis Minor, supra*.

*Araxes.*—See under *Solis Lacus*.

*Cerberus*, *Cyclops.*—These two canals constitute the greater part of the Huggins Inlet of Proctor's "Map of Mars."

* Although the average canals are here called "faint," it must not be supposed that they were very difficult objects. On the contrary, these average canals were easily seen upon any pretty good night.



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September 8, *Cyclops* and *Cerberus* seen plainly, and though def. was very poor they were suspected double. September 9, both canals plainly double. *Cerberus* was very intense, almost blackish; *Cyclops* considerably fainter, though quite evident. September 11, def. pretty good. *Cyclops* rather faint, but distinctly double. It made a considerable angle with *Cerberus*. At its mouth there was a distinct bay. *Cerberus* rather dark and plainly seen double, though the interval between the components was very small. September 18, though def. was very bad, both canals were seen plainly towards the f. limb, and were, moreover, seen double quite distinctly. September 19, *Cyclops* moderately dark, broad, clearly double, yellowish grey in tint; *Cerberus* dark, broad, very plainly double, more blackish than *Cyclops*. In October this portion of Mars was enveloped in cloud, and both canals were invisible. Only on October 19 the mouth of *Cyclops* could be faintly seen. The November observations were unsatisfactory, but on the 23rd *Cyclops* was noted as being very faint.

*Chrysorrhoas.*—August 26, seen distinctly, narrow and definite. September 26, dark, well defined, rather broad, plain, almost certainly double. September 28, quite plain, though not certainly double, def. very poor. September 29, def. very fair, canal certainly double, the s.p. component being rather narrower and fainter than the n.f. one. A bright yellow streak was visible crossing the canal almost at right angles. At first sight this bright yellow streak seemed to obliterate the double *Chrysorrhoas*, but on closer scrutiny the two bands of the canal could just be traced across the yellow streak. Rather curiously traces of the yellow streak were still visible a month later. November 4, *Chrysorrhoas* plain, moderately dark, certainly double. November 5, distinctly double, though narrower, and not so conspicuous as the *Ganges*. The component lines were distinct, and the space between them bright (*see* Fig G.). When best seen both components of this

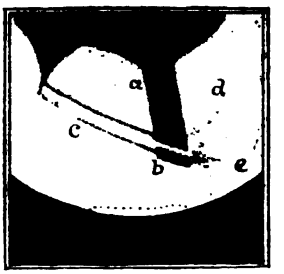


Fig. G. *Lacus Lunæ.*—1894, Nov. 5.

canal were obviously irregular on the edges, and spotty in appearance.

*Eumenides-Orcus.*—On September 23 and 26 *Eumenides* was seen, but it was faint, indefinite, and inconspicuous. On November 23 and 24 *Orcus* was rather dark, broad, and definite, and strongly suspected to be double. On November 25 the duplicity of the *Eumenides-Orcus* was certain, though not very distinct.



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*Eunostos.*—Seen plainly double on September 9 and 11 from its junction with *Cyclops* as far as the end of *Elysium*. From thence it was narrower, feebler, and single. It was greyish, and not very dark.

*Ganges.*—This canal was composed of two rather broad, diffuse, parallel streaks of a yellowish grey tint, the two streaks being rather widely separated. The space between was not bright, but of a yellowish grey, somewhat paler than the streaks themselves. The whole formation was rather faint, diffuse, and indefinite, though from its large size the canal was a conspicuous object; and owing to its components being widely separated it could easily be seen double on almost any night, however bad. At its mouth it widened out, so as to form a distinct bay or inlet from the *Auroræ Sinus*. It will be seen from Fig. G. and the drawing of the *Solis Lacus* region on p. 126, that the *Ganges* was not double exactly in the same manner as described by Schiaparelli. According to this observer, the duplicity was formed by a new canal through *Fons Juventæ* appearing to the right of the old single canal. But in 1894 both components of the double *Ganges* were to the left of the place of *Fons Juventæ*. The following are the dates on which the *Ganges* was seen double distinctly in 1894:—August 29; September 26, 27, 28, 29, 30; November 4, 5. At the N. end of the *Ganges*, *Lacus Lunæ* appeared as a small, definite, dark spot. On November 5 this lake was seen clearly double, as shown in Fig. G. The duplication was rather curiously not related to the conspicuously double *Ganges*, but to the relatively very feeble double *Hydrastes*, the double lake appearing merely as thickenings and intensifications of the two lines of the latter.

*Gehon.*—Seen double clearly with power 320 on August 29. The new component started from the p. inlet of Dawes' Forked Bay, and continued parallel to the original canal, following the curve of the latter. The space between the two components appeared greyish, and this greyish appearance also affected *Fastigium Aryn*, rendering the forked character of Dawes' Forked Bay less obvious at this time than usual. The bay itself appeared almost black, immensely darker than the two streaks of the *Gehon*. The p. streak was slightly more feeble than the f. one. The canal was was also seen double on October 3 and 7.

*Hydrastes.*—Distinctly double on September 29, the component canals being narrow and well separated, but not very dark. Also double on September 30, when it was thought to be plainer than on the 29th. On November 5 it was seen clearly double, as shown in Fig. G, in which *a* = *Ganges*, *b* = *Lacus Lunæ*, *c* = *Hydrastes*, *d* = *Chrysorrhoas*, *e* = *Nilus*. The last-named appeared dark and plain, but it was too close to the limb to say if it was double or not.

*Titan.*—Strongly suspected double on November 23, but def. was bad. On November 25 a large, faint, indefinite, dark patch was seen at the place where the canals *Orcus*, *Eumenides*, *Avernus*, and *Titan* meet or cross. S. of this patch *Titan* was faint, but broad and distinctly double. N. of it the canal was



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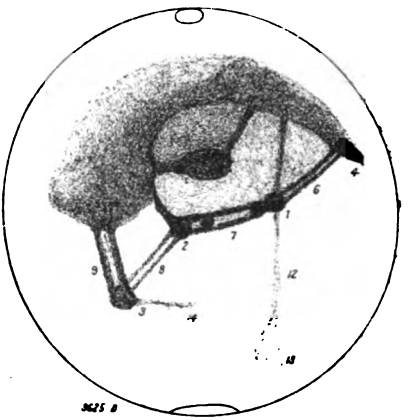
very faint, and probably, though not certainly, double. In an interesting drawing by Mr. Lowell, made with an 18-in. refractor,* the above-mentioned patch is resolved into a triangle of three small dark spots or lakes.



Longitude about 90°.

Fig. H. *Solis Lacus.*—1894, September 23, 26, and 29.

| | |
|---|---|
| 1 = *Lacus Phœnicis,* | 8 = *Chrysorrhoas.* |
| 2 = *Lacus Tithonius.* | 9 = *Ganges.* |
| 3 = *Lacus Lunæ.* | 10 = *Nectar.* |
| 4 = *Mare Sirenum.* | 11 = (*Unnamed canal.*) BATHYS |
| 5 = *Phasis.* | 12 = *Iris.* |
| 6 = *Araxes.* | 13 = *Ceraunius.* |
| 7 = *Agathodæmon.* | 14 = *Uranus?* |

*Solis Lacus and neighbouring region.*—Some pretty good views were obtained of this part of the planet on several nights in the latter part of September. The principal markings then seen have been laid down in the drawing published on p. 150, Vol. V., of the "Journal," which drawing is also reproduced here. Further details are given in the following notes.

September 23, $11^h$ to $12^h$ $10^m$.—Def. pretty good, but cloud nearly continuous. *Solis Lacus* appeared rather dark and of a peculiar inky tint. It was pear-shaped, the stalk of the pear being formed by the *Nectar*, which was dark and definite. The unnamed canal 11 was also dark, definite, and well marked. This canal was discovered by Burton in 1879, in which year it was strangely missed by Schiaparelli.

September 26, $11^h$ $20^m$ to $12^h$ $20^m$.—Def. fair, but unsteady. *Solis Lacus* very dark and inky-looking, but its surroundings were so dusky that it was not a very prominent object. *Thaumasia* between the *Nectar* and the unnamed Canal 11 was dark and strongly reddish. *Nectar* broad, very dark, very well defined. Canal 11 plain, dark, very well defined.

* "Astronomy and Astro-physics," December 1894, Plate XLII., Fig. 7.



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September 29, $14^h$ to $15^h$.—Def. fair, but obs. interrupted by cloud. *Solis Lacus* very dark and inky-looking, but owing to *Thaumasia* being dark and ruddy, it was not very prominent. It was much elongated E. and W. *Nectar* broad, very dark, very well defined. Canal 11 moderately dark, well defined. The *Eosphorus* was invisible, and no other canals could be seen issuing from the lake.

October 28, $7^h$ $35^m$ to $7^h$ $50^m$.—Def. pretty good, but obs. interrupted by cloud. *Solis Lacus* only moderately dark, though blackish in tint. Once it appeared double, or divided into two by a light streak running from n.p. to s.f., and making an angle of about 45° with a meridian line through the centre of the lake. Owing to cloud it was impossible to confirm this. The *Eosphorus* plainly visible, though in September it could not be seen. It was dark, well defined, conspicuous.

November 4, $9^h$ $50^m$ to $10^h$ $30^m$.—*Thaumasia* quite dull and inconspicuous, and not clearly defined on its s.p. side. *Solis Lacus* inconspicuous on account of the dulness of *Thaumasia*.

December 1, $5^h$ $45^m$ to $6^h$ $50^m$.—Def. poor. *Solis Lacus* seen as a very black-looking spot, with *Nectar* as a very black-looking streak.

It sometimes happens that certain markings, probably from some peculiarity of appearance, are more easily apparent to some observers than to others. This has been the case here with the canal *Ambrosia*, of which I could never see a trace, although it has been well observed by both M. Antoniadi and Herr Brenner. On the other hand neither of these two observers appears to have seen the unnamed canal 11 more to the N.; and, as already mentioned, this last-mentioned canal was missed by Schiaparelli in 1879, although seen by Burton.

The following notes relate to the double canals *Agathodæmon* and *Araxes*:—

September 23.—*Agathodæmon* distinctly double, the component lines being very dark and definite. *Araxes* also double, but not so plain or so dark.

September 26.—*Agathodæmon* broad, dark, very clearly double, well-defined. *Araxes* seen beautifully double, but closer than the other. It was broad, dark, well-defined.

September 27.—*Agathodæmon* very intensely double, the duplicity being obvious, although def. was poor.

September 29.—*Agathodæmon* broad, very dark, well-defined, double. *Araxes* narrower, very dark, very well-defined, also double.

October 28.—*Agathodæmon* very dark, definite, and double; but *Araxes* was quite faint and inconspicuous, in great contrast to its September appearance. It was slightly suspected to be double. *Lacus Phœnicis* too was faint compared with what it was in September. The faintness of these two markings was perhaps due to thin cloud, the remains of some of that which blotted out the f. part of the *Mare Sirenum* and the *M. Cimmerium* earlier in the month.



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In September the *Phasis* was extremely feeble, and the *Aonius Sinus* almost invisible, the surface about here being bright and white, and I quite agree with M. Antoniadi in ascribing this abnormal appearance to the presence of clouds on Mars. Cloud appears in fact to be much more common upon Mars than has been supposed to be the case by some observers of late years, though when present it may not always be dense or continuous enough to absolutely hide the surface markings.

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## Report of E. M. Antoniadi.

### I. JUVISY OBSERVATIONS.

$9\frac{3}{4}$ in. G.G. Power 220.

Greenwich Mean Time is used in all cases.

July 1, $15^h\ 50^m$, diameter $10''\cdot9$, $\lambda = 228°$.—Good def. The S. polar cap is very white and of enormous dimensions; its diameter occupying at least 40° (areocentric arc). *Mare Cimmerium* is on the central meridian. To the right, *Hesperia*, also *Syrtis Minor* and *Mare Tyrrhenum*. *Ausonia* is badly defined and very white in the vicinity of E. limb. (The canals *Cyclops* and *Cerberus* are easily seen. Drawing made.)

August 5, $12^h\ 50^m$, diameter $14''\cdot0$, $\lambda = 213°$.—Very fine seeing. The S. polar cap is not very brilliant. *Mare Cimmerium* is on the central meridian. To the E. *Mare Tyrrhenum* with *Hesperia*. To the W., the eastern extremity of *Mare Sirenum* with *Atlantis*. All the region to the S. is badly defined. *Zephyria* looks very white on terminator; so also *Ausonia*. (The canals *Cyclops*, *Cerberus*, and *Laestrygon*, are visible without difficulty. Drawing made).

August 23, $11^h\ 50^m$, diameter $16''\cdot1$, $\lambda = 28°$.—Good def. The S. polar cap is now very reduced, and is bordered by a dark belt. *Aromatum Prom.* is almost on the central meridian. *Auroræ Sinus* is dark, *Margaritifer Sinus* considerably lighter, *Noachis*, *Argyre*, *Ogygis Regio* are seen as one land extending up to the terminator. The *Ganges* is much darker than the *Indus*. Drawing made.

August 27, $14^h\ 50^m$, diameter $16''\cdot7$, $\lambda = 34°$.—Very fine weather. The S. polar cap is roughly triangular; subtends some 12° (areocentric arc). *Auroræ Sinus* is dark, *Lacus Niliacus* is a plain feature near the N. limb, where the snow extends down to + 55° of latitude in *Tempe*.

August 27, $15^h\ 50^m$, $\lambda = 49°$.—Def. good. *Margaritifer Sinus* with the *Indus* is setting on the terminator, while *Auroræ Sinus* is now central. The N. snows on *Tempe* are very brilliant, though reduced to a simple arc. Drawing made.

August 28, $11^h\ 50^m$, diameter $16''\cdot8$, $\lambda = 341°$.—Fine weather. *Sinus Sabæus* is very dark, especially towards "Dawes' Forked Bay" and the mouth of the *Euphrates*. *Deucalionis Regio* is easy, but *Pyrrhæ Regio* is almost invisible. Drawing made.



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September 7, $13^h\ 51^m$, diameter 18″·3, $\lambda = 277°$.—Very fine seeing. The S. polar cap is very small. *Syrtis Major* is very dark, especially towards its N. end and the *Nilosyrtis*. *Ausonia* indistinct. *Hellas* a little better defined, shows from time to time the curious cross formed by the intersection of the canals *Alpheus* and *Peneus*. The *Syrtis Minor* is dark, receiving the *Lethes* from the N. *Lacus Mœris* is easy. Drawing made.

September 15, $10^h\ 21^m$, diameter 19″·3, $\gamma = 153°$. The air is very calm and steady. Fine seeing. The S. polar cap is very narrow and difficult; it is probably excentric to the areographic pole, being now on the other side of it. *Electris* and *Eridania* are white on E. limb. Drawing made.

October 31, $9^h\ 51^m$, diameter 20″·4, $\lambda = 97°$.—Good def. The S. polar cap is almost invisible. *Solis Lacus* has passed the central meridian; it is very dark, and elongated from E. to W., or rather from E.S.E. to W.N.W. *Auroræ Sinus* appears lighter than usual, and the *Mare Australe* S. of *Thaumasia* is almost indistinct. *Thaumasia* is probably shaded, presenting a colour fully comparable to the dark brick red of *Deucalionis R*, *Noachis*, &c. *Aonius Sinus* is quite invisible, and as much might be said of all the region S.E. of *Solis Lacus*.

November 1, $10^h\ 51^m$, diameter 20″·2 $\lambda = 100°$.—Beautiful def. The S. polar cap is glimpsed from time to time as a small white spec separated from the limb. The *Solis Lacus* is so dark that it appears sometimes black near the central meridian; it is distinctly elongated from E. to W. (E.S.E. to W.N.W.). *Auroræ Sinus* and *Mare Australe* well defined, but the *Aonius Sinus* and *Icaria R.* are scarcely recognised as compared with Schiaparelli's maps. *Thaumasia* somewhat dusky. *Argyre* is very white near the S.W. limb, and so are the northern snows in *Tempe* also. Drawing made.

## II. PARIS OBSERVATIONS.

$4\frac{1}{4}$-in. O.G. Power 200.

October 23, $8^h\ 21^m$, diameter 21″·5, $\lambda = 145°$.—Glorious night. No S. polar cap visible. *Mare Sirenum* is on the central meridian. *Sinus Titanum* very dark.

October 30, $8^h\ 51^m$, diameter 20″·5, $\lambda = 91°$.—Air very steady. No S. polar cap visible. *Solis Lacus* central, it is exceedingly dark, almost black by moments. *Auroræ Sinus* looks lighter, also the sea surrounding *Thaumasia*.

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## Report of E. Walter Maunder, F.R.A.S.

Instrument used, 28-in. Refractor.

August 29, $13^h\ 20^m$ and $13^h\ 40^m$. Power 360.—Two sketches made. Dawes Forked Bay distinctly seen, the two estuaries being clearly discovered, but the two canals flowing into them were not seen.

*Deucalionis R.* was also distinctly seen, and the isthmus fully made out. The marking appeared as shown by Schiaparelli and not like Phillips Island in Green's map.



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The *Terminator* was diffused and quite unlike the full limb in appearance. No irregularity or projection was, however, detected upon it.

The polar cap was of a perfectly regular elliptical outline; very bright, no indentations. The sea round it was dark for a narrow space.

Herschel II. Strait was the darkest marking on the planet. It was closed at the following end by *Deucalionis Regio*.

The entire district between the pole and *Herschel II.* strait was less bright than Beer Continent, and at the first casual view appeared of one uniform tint. Closer inspection showed that the region was filled with markings of perfectly definite outline, but of such delicate differences of tone and shade as to defy reproduction.

The *Fastigium Aryn*, though distinctly seen, was of a lighter tint than the neighbouring Continent, and the old representation of *Mädler* showing the strait ending in a circular knob would have been quite justified if the planet had been less well seen.

Similarly Phillips Island, though clearly and distinctly united by a well defined isthmus to Beer Continent, was occasionally seen as a cigar shaped island as in Green's chart, owing to the isthmus being fainter than the island.

So too the De la Rue Ocean to the south of *Chryse* showed at least two regions of definite outline but of delicate differences of tone.

Proctor Cape was very bright = $W_3$; *Argyre* whitish = $W_1$; the polar cap being $W_4$.

*Noachis* was of a half tint. Beer Continent was the reddest region visible and was of a full orange. The *Terminator* was not so bright or so white as the full limb.

August 31, $13^h\ 32^m$. One sketch made. Power 500.—The polar spot was not so sharp and well defined as on August 29. A few ill-defined white markings were seen close below the polar spot near the central meridian. The markings were of $W_3$ intensity, but small and with diffused edges, so that they were very difficult to hold, and the few scratches put in to represent them are simply to give their general effect.

The Hook at the *Hammonis Cornu* was only suspected, not steadily seen, so is not given in the sketch.

Proctor Cape was less bright than on August 29, and less distinctly white, say $W_2$. Miss Russell, who observed the planet at the same time, but who made no sketch, detected a narrow white line stretching across the *Sabæus Sinus* from Proctor Cape. I could detect nothing of the kind.

Beer Continent was more distinctly ruddy than on August 30.

The difference in aspect between the terminator and the limb was very marked. The former diffused, and no brighter or whiter than the general disk; the latter sharp and quite $W_1$ if not $W_2$ as to whiteness, and very distinctly brighter than the general disk.

The seas appeared a natural grey, the *Sinus Sabæus* being the darkest. In the region to the S. the contrasts are much less marked, the grey spots are lighter, the bright spots duller than



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near the equator. It is, therefore, a matter of difficulty to separate one from the other.

Def. fair, but inferior to what it was on August 30.

September 5.—Two sketches made, $13^h\ 49^m$ and $14^h\ 20^m$. Power 360. Def. very bad at midnight, but improving later, though only poor at the best.

Polar cap very small, smaller than drawn, difficult to see, not very bright. *Hellas* showed its northern coast line = $W_1$ or $W_2$; the brightest part of the planet after the polar cap or limb. Terminator better defined than on August 31, but still not so bright or well defined as the limb.

A faint diffused marking was noted in the centre of *Hellas*, possibly a trace of a canal. Beer Continent was ruddy. One canal was seen in it, Typhon? Several faint diffused patches were seen in the De La Rue Ocean, but they were too faint and diffused to locate or draw.

The *Hammonis Cornu* was again suspected, but not drawn. So the *Lacus Mœris* likewise was suspected, but not drawn.

September 26.—Def. very bad. Image boiling furiously. The planet very bright, but merely a great yellow flaring naphtha lamp. The seas were the faintest possible markings, but so far as anything could be made out at all, Hussey's and Keeler's drawings of the region of the Terby Sea in 1892 was confirmed.

It was utterly unlike anything I had ever seen in this region before. It was hopeless to attempt a sketch, the image being so diffused and unsteady.

November 5.—Observed from $10^h\ 30^m$ to $13^h\ 30^m$. Def. bad, light vapour continually passing over the planet. No markings were seen on the planet; it was just a ruddy blur. A fair set of measures of both *Deimos* and *Phobos* were, however, secured.

October 25.—In a brief note on Mars for this date it is recorded that the planet showed no markings whatever.

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## General Notes by Members of the Section.

The preceding reports are given in full. The following notes are derived from the reports or drawings of the remaining observers, and refer principally to points not touched upon in the general summary. In some cases also matters referred to in the summary are here treated at slightly greater length.

The following Members contributed drawings or reports or both:—

Capt. W. Noble, F.R.A.S., the Revs. Jas. Baikie, F.R.A.S., P. H. Kempthorne, F.R.A.S., Beamish Saul, and W. R. Waugh, F.R.A.S.; Drs. Gordon Paterson and D. Smart, F.R.A.S; and Messrs. G. L. Brown, Bernard Cammell, F.R.A.S., G. T. Davis, Henry Ellis, A. Henderson, Willoughby Meares, Arthur Mee, F.R.A.S., C. Roberts, F.R.A.S., and C. A. Taylor, F.R.A.S.



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OBSERVATIONS BY A. HENDERSON.

At times the details were so blurred and covered with numerous white patches, as to force me to the belief of extensive areas of Martian cloud. No maps or drawings were consulted until all the drawings had been made. The longitudes of the central meridian were then computed, and the aid of Schiaparelli's maps called in, to identify as far as possible the various workings. A very pale neutral tint cap was frequently used with great success to reduce the glare of the planet. July 29, $14^h\ 20^m$, $\lambda = 301°$. Def. fair, p. 150–210. S. polar cap smaller and less conspicuous than when last seen (July 11, $15^h$, when it was the only prominent feature, being extremely large and bright). *Hellas* very bright, especially just E. of central meridian, and when it borders the *Hadriaticum Mare*, a bright marking W. of this to limb very diffuse and not so bright as *Hellas*. *Sinus Sabœus* traced to limb as a diffuse greyish marking, and darkest just in E. limb, when it is faintly mottled. *Ausonia* in W. limb appears as a very bright patch, much fainter and diffused into neighbouring sea. *Libya* and *Aeria* very bright. *Nilosyrtis* rather faint. *Hadriaticum Mare* darkly mottled. August 22, $13^h\ 20^m$, $\lambda = 58°$. Def. poor, p. 150–415. S. polar cap very brilliant. *Icaria* in S.E. limb ill-defined, more like a convex brightening of the limb. *Argyre* dull, an ill-defined oval spot. *Thaumasia* bright and conspicuous, boldly cut-lined, especially near *Aonius Sinus*. *Protei R.* suspected. *Chryse* very faint, best seen with high power. *Aromatum Prom.* the best defined and brightest portion of Chryse. *Margaritifer Sinus* greyish tint. *Deucalionis R.* and *Pyrrhæ R.*, bright and conspicuous. *Noachis* very bright in terminator, fainter towards central meridian. September 4, $13^h\ 55^m$, $\lambda = 305°$, Def. unsteady, p. 210 to 415, drawing made. S. polar cap small but intense. *Hellas* extremely bright. *Deucalionis R.* in E. limb bright and prominent. *Aeria* reddish in tint. *Libya* and *Ausonia* not very bright. *Syrtis Major* dark grey. *Tyrrhenum Mare* faint ill-defined spot. *Mare Australe* faint, greyish tint. September 8, $14^h$, $\lambda = 270°$, def. sharp, p. 210 to 415. S. polar cap very small but intense. In S. hemisphere a bright zone extending from proximity of *Promethei Sinus* to S. confines of *Aeria*, where it widens out brightest just E. and W. of C. M. The *Mare Australe* thrown into contact by this band (Martian Cloud). *Libya;* with high power. *Lacus Mœris* seen with *Nepenthes* canal; difficult object, ill defined. *Isidis R.* extremely bright N. of *Nepenthes*. *Syrtis Minor* conspicuous and dark. *Eridania* very bright in terminator with p. 415. Suspected to be serrated. Has this been independently observed? September 10, $13^h\ 25^m$, $\lambda = 243°$. Def. good, p. 210 to 415. S. polar cap very difficult. The bright stripe in S. hemisphere has partially cleared. S.E. side of *Hellas* very bright. *Aeria* brightest in wedge, confused in S. *Syrtis Minor* very dark and greenish grey in tint. September 12, $12^h\ 35^m$, $\lambda = 212°$. Def. poor, p. 225. S. polar cap only suspected. Details very indistinct, the broad stripe across S. hemisphere broadest and brightest in about long. 182°. *Syrtis Minor* the darkest and sharpest feature in disk. Just S. *Hadriaticum Mare*



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darkly mottled. September 16, $12^h\ 12^m$, $\lambda = 170°$.—Def. poor, p. 210 to 262. S. polar cap very small. *Thyle* and *Mare Chronium* visible. *Mare Sirenum* and *Mare Cimmerium* fairly dark; faint and diffused into *Icaria* and *Phætontis*. *Zephyria* very bright in its S. edge near C. M. In best moments of def. canal *Titan* seen. September 27, $12^h\ 40^m$, $\lambda = 78°$.—Def. bad, p. 150 to 262. S. polar cap very small, faint dark shading encircling it. *Aonius Sinus* faint and sharp. *Icaria* bright but diffuse. *Phasis* only seen in best moments of definition. *Deucalionis R.* conspicuous. S. of this the W. limb is bordered by indefinite white patches. September 28, $12^h\ 50^m$, $\lambda = 71°$.—Def. poor, p. 150 to 262. S. polar cap only suspected. White patch still in S. hemisphere. *Pyrrhæ R.* bright. *Protei R.* as faint light spot. September 29, $12^h\ 30^m$, $\lambda = 58°$.—Def. good, p. 210 to 415. S. polar cap vivid and very large, faint dark zone surrounding it. The stripe in S. hemisphere narrower. *Icaria* bright to limb. Portion of *Phasis* visible. A bright spur between the *Sinus* and *Thaumasia* clear from surrounding light marking, divided by narrow sharp line from *Thaumasia*, which was bright in S. edge. *Aurora Sinus* distinct, bordered brightly by *Aurea Cherso* (?). *Protei R.*, *Pyrrhæ R.*, seen as one. *Deucalionis R.* dull and towards W. limb, brightest at E. edge. *Argyre* and *Ogygis R.* very faint. October 1, $12^h\ 25^m$, $\lambda = 38°$.—Def. good, p. 150 to 262. S. polar cap very bright, seeming to project beyond limb; no dark encircling zone. Bright S. patch duller, and broken with shading. *Aonius Sinus* narrow. *Thaumasia* and *Icaria* bright on W. edges. *Aurora Sinus* small and dark. *Margaritifer Sinus* has a dark spot joined by a faint connexion with *Aurora Sinus*, see Obs., September 29. *Protei R.* rather dull. *Deucalionis R.* very bright at limb. *Noachis* vague. *Argyre* and *Ogygis R.* faint.

BERNARD E. CAMMELL, F.R.A.S., supplies the following additional notes:—

S. polar cap, August 26, surrounded by narrow dark zone, wider on the p. side; August 29–30, observation repeated; August 31, September 5, 26, getting smaller; October 7, very faint; October 15, very indistinct if seen at all. *Syrtis Major*, August 29, apparently connected with S. pole by a dark sea; August 30, greyish blue in colour; September 5, blue grey; *Mæris Lacus* seen as a faint spot, joined to *Syrtis* by a faint shading; October 7, well-defined, beautiful blue grey. *Syrtis Minor*, September 5, well seen, blue-grey in colour; October 15, large and dark, with *Amenthes* leading out almost due N. *Solis Lacus*, September 26, very dark, joined to *Mare Erythræum* by a faint shading near the preceding end of *Thaumasia* and elongated in the E. to W. direction; September 27, observations repeated.

The Rev. J. BAIKIE, F.R.A.S.—September 12, $11^h$—$11^h\ 30^m$, $\lambda = 193°$.—A bright patch where *Atlantis I.* joins *Zephyria*. September 14, $10^h\ 45^m$—$11^h\ 15^m$, $\lambda = 167°$.—S. polar cap small. *Mare Sirenum*, a bright patch s. p. end *Dædalia*. September 26, $10^h\ 30^m$—$11^h$, $\lambda = 55°$. Definition good. *Pyrrhæ R.* and *Protei R.* bright, *Deucalionis R.* passing off disk. S. polar cap very small. October 8, $9^h$ — $9^h\ 50^m$, $\lambda = 287°$.—



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*Syrtis Major* with small dark bay on p. side, extending in direction of *Lacus Mæris*. *Hellas* divided by a faint shading, probably *Alpheus Canal*. October 10, $9^h\ 30^m$—$10^h$, $\lambda = 276°$,—*Syrtis Minor* dark, *Syrtis Major* with same dark bay on p. side. *Ausonia*, *Hellas*. October 11. $9^h\ 30^m$—$10^m$, $\lambda = 267°$.—*Syrtis Minor* large, with *Lethes* projecting northwards some distance. *Syrtis Major* with same dark bay on p. side. The dark markings in the planet, as a rule, were of a slaty greenish grey. A map was never consulted before going to telescope. October 2, $8^h$—$9^h\ 20^m$. The regions between long. 320°—20°.—The most prominent part here was the bright line of coast on the S. of *Edom*, which appeared broken up into a number of small bays. The high lights had a beaded appearance. A faint long patch between *Edom* and *Deucalionis Regio*, the latter being larger and brighter. The shading was very delicate at its extremities, the outline being very hard to distinguish. The whole of these regions had a beautiful streaky appearance, in colour cool and shaded ivory. October 8, $9^h\ 5^m$—$10^h\ 50^m$, long. 220°—320°.—*Hellas* when definition was good appeared divided into three parts. The division of *Hellas* (*Alpheus* probably) several times glimpsed. N. of it several faint patches of light. Similar markings seen near *Hammonis Cornu*. On one occasion this cape appeared detached from the mainland. November 22, $7^h$—$8^h\ 8^m$,—Definition very fine. The long island of *Cimmeria* and *Hesperia* well defined. The latter seemed to join the mainland, but was narrower here than Schiaparelli draws it. *Elysium* seen. When definition was extra good small angular patches of shade were seen on the continents. November 26, $10^h\ 20^m$—$11^h\ 5^m$.—Air steady. Detail well seen. The fine surface marking seen on the 21st October and 22nd November on *Zephyria* and *Aeolis*, not seen on this occasion. It had then appeared as an extremely delicate and faint irregular network of lines, principally on *Memnonia* and *Zephyria*, and was very difficult to sketch.

These observations have shown us in a very conclusive manner the correctness of Schiaparelli's maps. Eighteen canals were seen altogether. Unfavourable weather prevented me from seeing several interesting parts of the planet, especially the *Solis Lacus* region.

G. T. DAVIS.—September 26 and 28, *Argyre*, *Noachis* and *Deucalionis Regio* seen, October 2, definition very good; polar cap barely visible at $9^h\ 50^m$; it seems to lie towards $\pm\ \lambda = 60°$; *Hellas* white and bright on terminator; *Deucalionis*, *Pyrrhæ R.* and *Argyre* all very well seen—like an engraving.

In observations later than October, *Hellas* always appeared ruddy. The rosy red tint of the most conspicuous continental regions was not so apparent after the end of November. Mr. Davis considers that it was a favourable opposition for small apertures.

THE REV. P. H. KEMPTHORNE, F.R.A.S.—September 26th. $10^h\ 30^m\ \lambda = 55°$. *Jamuna*, *Ganges* seen; *Solis Lacus* faint; light streak above *Thaumasia*; *Lunæ Lacus*; part of *Uranius* seen; *Aonius Sinus* invisible. September 28th. $11^h\ 30^m\ \lambda = 52$.



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*Lacus Tithonius* with *Agathodæmon* canal. *Solis Lacus* small and dark. *Nectar*. Dark sea above *Thaumasia*. *Protei Regio* light, *Deucalionis R.* dull. *Lacus Niliacus*, *Lunæ Lacus*. October 14th $\lambda = 265$. Visible *Syrtis Minor* dark, with part of *Lethes*. Bright patch on *Cassini Land* and *Eridania*. October 16th. $\lambda = 250$. Polar cap just distinguishable. Not a trace of *Mare Hadriaticum*. *Syrtis Minor* dark with *Lethes*. *Mare Cimmerium* has vanished all but a fragment at the f. end. *Æthiops* and *Cassini Land* very bright. October 22nd $9^h\ 15^m$ $\lambda = 167°$. Markings in disk very faint. *Mare Cimmerium* invisible. Dark patch below S. pole.

ARTHUR MEE, F.R.A.S.—In observations of September 6, 10, 12, 13, 14, and 18, the S. polar cap is not noted; September 19, very small and bright; trace of shading on each side September 26, bright; October 2, 7, and 8, visible; October 12, very faint; not seen subsequently. *Deucalionis R.* was ill defined on October 2; whitish October 7, *Xisuthri R.* suspected October 7. *Aeria*, when on limb, September 6, was very bright; reddish on October 7, and unlike the maps in shape; reddish, October 8.

CAPTAIN W. NOBLE, F.R.A.S.—October 15, $10^h\ 45^m$ $\lambda = 252°$. *Syrtis Minor* large with the *Lethes* branching due north from it; detail much fainter and less well defined towards the eastern limb than towards the western or on the centre of the disk, November 26. Captain Noble remarks "during the present opposition it has "always seemed to me that detail has been hazier and less distinct "towards the following limb of the planet."

Dr. GORDON PATERSON.—October 7, $9^h\ 30^m$, $\lambda = 303$.—*Aeria* deep orange colour, with the *Typhon* and *Orontes* canals visible. A large circle of light surrounding S. polar cap. October 12, $10^h$, $\lambda = 266°$.—*Syrtis Minor* small, *Lethes* not seen. S. polar cap well seen. October 14, $10^h\ 15^m$, $\lambda = 252°$.—*Syrtis Minor* rather small, *Lethes* not visible. *Syrtis Major* rather narrow, f. edge of *Libya* bright. October 15, $9^h\ 15^m$, $\lambda = 244°$.—Def. fluttering. *Hesperia* and *Eridania* large and bright. *Tyrrhenum Mare* dark; *Syrtis Minor* small. Same bright streak on f. edge of *Libya* as on 14th instant. October 21, $9^h\ 30^m$, $\lambda = 180°$.—*Mare Sirenum* very faint, with the faintest suspicion of *Titanum Sinus*. S. polar cap invisible.

C. ROBERTS, F.R.A.S., reports:—*Deucalionis Regio*, August 30, one of the brightest parts of the whole disk; September 1, very bright, extends over *Indus*. *Iapygia* and *Argyre*, September 5, bright. *Ausonia*, September 6, 8, and 11, bright spot. *Bright spots*, September 6, on either side of S. end of *Euphrates*; September 9 and 11, on *Phœtontis* at S. end of *Atlantis I.* *Solis Lacus*, Sept. 27, the dark spot in the corner of this lake is in almost exactly the same position as one on a drawing by Prof. Schæberle at Lick, September 1, 1894; also the canal from it northwards. The region to the N. of the lake between *Ganges* and *Sirenus* very like, on September 28, the drawings of Mr. Lowell, at Flagstaff this opposition, but quite unlike Schiaparelli's map. *Indus*, September 27, very dark and continued



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into the *Mare Erythræum*. Twenty-two drawings were made. Altogether, 35 canals were seen, of which 22 were well seen; 10 only part was seen; three were glimpsed; one canal, the *Jamuna*, was seen double. A map was never used for comparison while drawing at this telescope. When def. was good; the outlines of the markings always appeared very hard and sharply defined.

The Rev. BEAMISH SAUL.—August 27, $2^h$, $\lambda = 30°$. $6\frac{1}{4}$ reflector.—*Auroræ Sinus* shown well defined, with the *Jamuna* leading out of it. A line of broad shading crosses the *Jamuna* from S.E. to N.W., probably *Lacus Niliacus* and *Lunæ Lacus*. Faint shading round S. polar cap, which is large. October 2, $10^h$ $30^m$, $\lambda = 1°$. 10-in. reflector.—Shows the two forks of *Fastigium Aryn*, the p. one very small. The f. one much larger, with the commencement of *Gehon* leading out of it. *Deucalionis R.* visible, but not joined to *Thymiamata*. S. polar cap, with faint shading round, especially noticeable on p. edge. October 7, $9^h$ $30^m$, $\lambda = 301°$.—*Syrtis Minor* faint. *Sabæus Sinus*, with a glimpse of *Fastigium Aryn*. Trace of *Xisuthri R.* Part of *Deucalionis R.* S. polar cap well seen, with trace of shading round. October 12, $10^h$ $30^m$, $\lambda = 263°$. $8\frac{1}{2}$ reflector. —S. polar cap a mere speck. *Syrtis Minor* rather small. *Chronium Mare* rather dark, and *Xisuthri R.* The following part of the planet was very ill-defined, November 10–20.

DR. D. SMART, F.R.A.S.—October 16, $\lambda = 240$. Drawing shows unmistakably the peculiar aspect of the planet at this time. *Syrtis Minor* was drawn large, and extending some distance north, which extension is evidently the *Lethes*? (*Amenthes*) canal. The *Mare Cimmerium* is quite blotted out. Dr. Smart reports that he was much puzzled with the aspect of the planet at the time, and that he noticed during the latter part of October an almost total absence of markings, also that the S. polar cap was invisible. The weather, especially towards the end of the Autumn, was very unfavourable.

REV. W. R. WAUGH, F.R.A.S.—September 19, $10^h$. S. polar cap seen; a very bright patch to N.E. of cap as if cloud. Limb of planet all round unusually bright. October 13, $9^h$ $30^m$. Three irregular white markings in the southern portion of the disk which could not be identified. November 19, $9^h$. Two bright spots glimpsed on the terminator. December 18, $5^h$. Two bright spots on terminator plainly seen.

*Note by Director.*—This drawing shows the *Kaiser Sea* very well with a small bay extending into *Aeria* on the *f* side of the *Kaiser Sea*, at a point where the *Typhon* debouches. A similar bay was shown in a drawing by J. T. Wood on October 14.

January 1, $8^h$. The two bright spots on the terminator were again seen during the evening. The southern one somewhat elongated.

J. T. WOOD. The colour of the continents was a decided pink, the dark markings a blue-black or blue-grey in colour; the colours seen well with reflector but not with refractor.



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October 1, $11^h$, $\lambda = 19°$. Moments of splendid definition phase just perceptible, S. polar cap bright. October 14, $10^h$, $\lambda = 252°$. Seeing good. S. polar cap not seen or very doubtful. Of the *Mare Cimmerium* on p. edge of disk, there does not appear any trace. On f. side of *Syrtis Major*, there is shown a very dark bay extending into *Aeria* at a point where the *Typhon* canal debouches. (*See* note by Director above.)

The COUNCIL of the Association regret the great delay which has taken place in the publication of the present report. The discussion and collation of the drawings and reports on the planet Mars must always be a laborious task, and proved a specially heavy one in the present instance. Mr. Cammell, the Director, prepared a report with great industry and care, but it proved to be too voluminous for the Council to undertake to publish in the form in which it was presented to them. Unfortunately Mr. Cammell was unable to spare the time necessary for a re-casting of the materials in his hands, and the report was necessarily laid on one side, until Mr. N. E. Green, with his usual devotion to the interests of the Association, undertook the task of giving it its present form.

The Council feels that the Association owes a very great debt to Mr. Green for undertaking so heavy a work, especially as he was already Director of an important Section, and for the skill and promptness with which he has brought it to a successful conclusion.

Mr. Green has altered the Report, which Mr. Cammell, the Director of the Section, had prepared, as little as was consistent with the imperative necessity of curtailing it very considerably.



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Fig 1. C. Roberts. 6½in Spec.
Sep 1. 16h 5m Long 5°.

Fig 2. T J Wood. 3½in O G Power 200.
Oct 1 11h Long 19°.

Fig 3. W. R. Waugh 12½in Spec. Power 200
Sep. 29 12h Long 50°.

Fig 4. P. H. Kempthorne 8½in Spec
Sep 26. 10h 30m Long 55°.

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Arthur Mee 8½in Spec Power 400
Sep 19.11h Long. 135°.

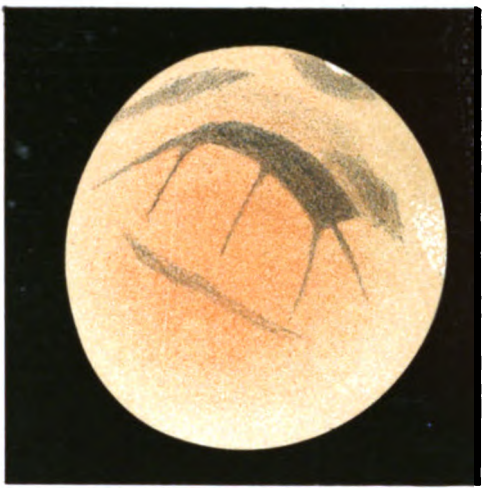

Fig. 8 E. M. Antoniadi. 9¼in O. G. Power 220.
Sep 15 10h 21m Long. 153°.

A. Henderson. 10½in Spec. Powers 210 &
Sep 16. 12h 12m Long 170°. 262.

Fig. 10. A. S. Williams 6½in Spec. Power 225.
Sep 19 15h 40m Long. 194

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Fig.13. J. T. Wood 3⅛ O.G. Power 200.
Oct. 14. 10h Long. 252°.

Fig.14. G. L. Brown 10¼in Spec, Power 173.
Oct. 11 9h 25m Long. 266°.

Fig.15. B. Cammell. 12½in Spec, Power 250.
Sep. 5. 12h 30m Long. 276°.

Fig.16 E. M. Antoniadi 9¼in O.G Power 220
Sep. 7. 13h 51m Long. 277°.

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E W Maunder. 28in O G Power 500.
Sep 1.h 32.m a m. Long 328°.

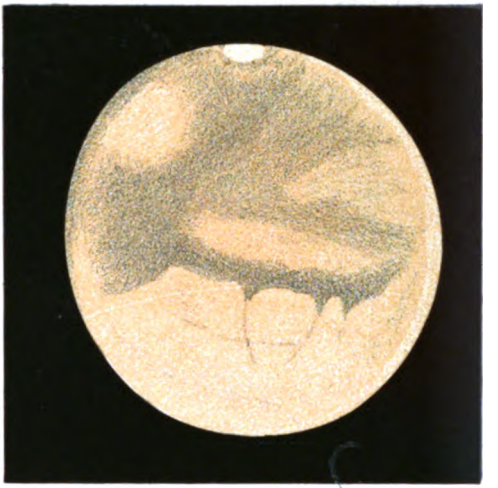
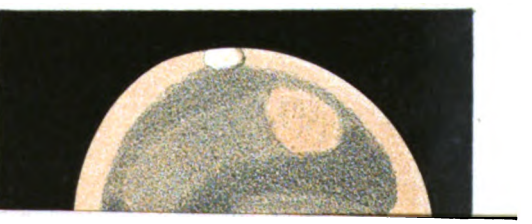


Fig 20. B Cammell 12½in Spec Power 250.
Aug 29 11h 40m Long. 329°.

E M Antoniadi 9¾in O.G; Power 220.
Aug. 28. 11.h 50.m Long. 341°.

Fig. 22. E W Maunder 28in O.G; Power 500.
Aug 30 1h 40m a m Long 348°.



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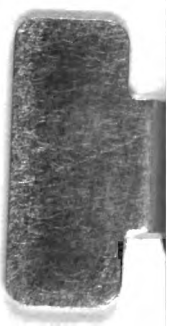

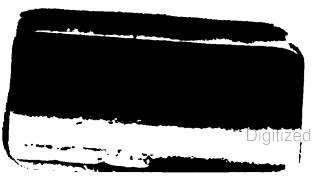

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